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Marine Engineering

AUGUST, 1905.

DEC 31 1905

NEW PASSENGER STEAMER LA PROVENCE.

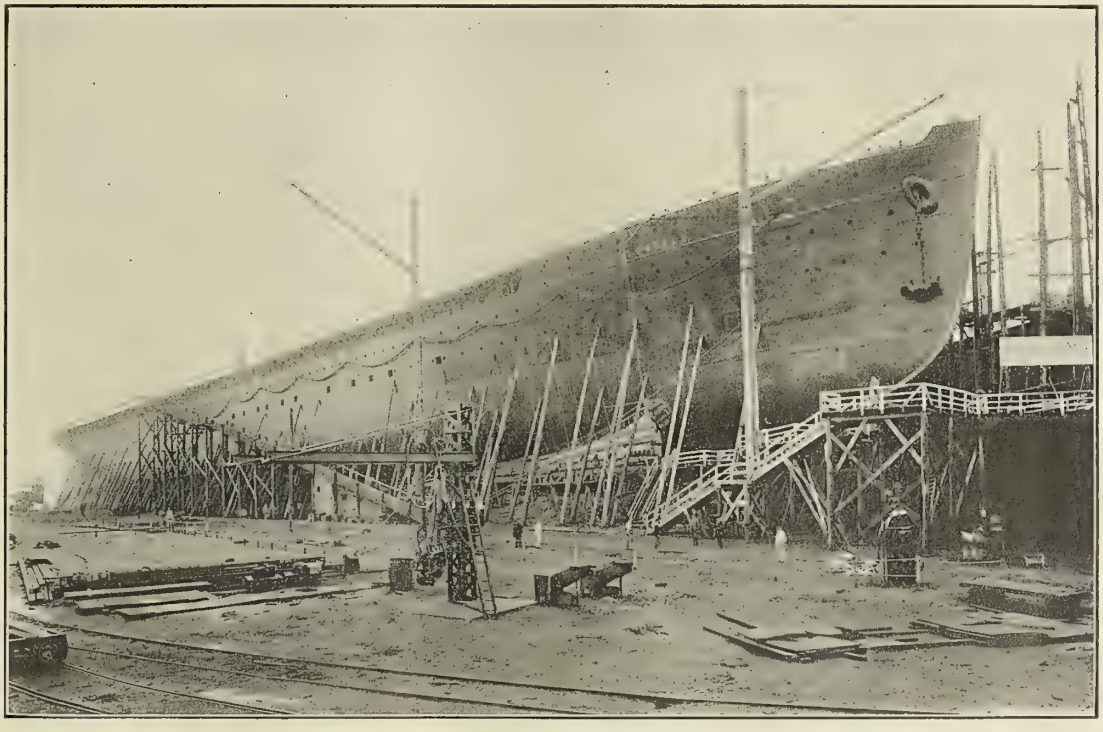
BY L. RAMAKERS.

On the 21st of March there was launched from the Peuhoët works at St. Nazaire, the passenger steamer *La Provence*,* destined for service between Havre and New York, which will be not only the fastest but at the same time the largest of all ships in the French mercantile marine. The length over all is 191 meters (627 feet); beam, 19.8 meters (65 feet); depth, amidships, 12.7 meters (41.7 feet); normal draft of water, 8.15 meters (26.75 feet); corresponding displacement, 19,190 metric tons (18,870 gross tons); coal capacity, 3,900 cubic meters (3,200 gross tons); horsepower, 30,000, actuating twin screws, with a speed of 23 knots. The number of passengers for which provision has been made is 397 of the first-class, 205 of the second-class, and 900 of the third-class, a total of 1,502.

The crew will be composed of 435 persons, which, with the full complement of passengers, will make a total of 1,937 persons who can be carried on this ship. The ship has been studied with a view of offering to the passengers not only the guarantee of absolute security but also of desirable comfort.

The general appearance is similar to that of the two last passenger steamers put in service by the Compagnie Générale Transatlantique, *La Savoie* and *La Lorraine*. The designers endeavored to realize in *La Provence* a greater speed than with the last two, and have been limited in the development of their ideas simply by the dimensions of the docks in the port of Havre. The construction of the ship has occupied a total of more than 1,800 workmen on the hull, engines, and boilers.

The hull is constructed entirely of Siemens-Martin steel, of which metal more than 8,000 tons has been used. A double bottom extends the entire length, except for a short space forward and aft. This is divided into ten water-tight compartments forming water ballast of a total capacity of 1,800 cubic meters (1,770 gross tons). The ship is divided from bow to stern into twenty water-tight compartments by twenty-one transverse bulkheads. As a general principle, with an aim at security, these bulkheads below the second deck are not pierced by doors of any description, and such water-tight doors as were found indispensable have been made in each case capable of being closed by arms and mechanism of hydraulic machinery, which permits closing them separately, or all at once, from the navigating bridge, in about twenty seconds. Thanks to this installation the most complete security is assured. In case water enters any compartment, the installation of steam pumps is capable of discharging about 3,000 tons per hour.



LA PROVENCE ON THE STOCKS.

*See MARINE ENGINEERING, May, 1905, page 206.

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As a means of additional precaution for the saving of passengers in case of disaster, there are twenty lifeboats and six life rafts. The lifeboats are fitted with a special arrangement permitting their being launched by four men each within a space of 40 seconds.

The ship is divided in its height by six steel decks which are named from the bottom: the fourth, third, and second decks, main deck, promenade deck, and awning deck. The four last decks are covered with wood of a mean thickness of 60 millimeters (2.4 inches). Above the awning deck there are two deck houses, one at the forward end containing the apartments of the captain and officers, surmounted by a small chart and pilot house, the latter being situated at a height above the water of 15 meters (49 feet); the other deck house, at the rear of the awning deck, contains a café and also a wireless telegraph station. The lifeboats and life rafts are placed upon this deck. The promenade deck extends the entire length of the ship, but the central part for a length of about 120 meters (394 feet) is devoted solely to passengers of the first-class. The forward and aft ends are occupied by winches and apparatus for hoisting cargo.

This deck in the part devoted to passengers carries two deck houses, the forward one having a length of 110 meters (361 feet), and containing the principal entrance for first-class passengers, the music and social halls, as well as a series of state rooms and apartments de luxe. Some of the latter include a cabin with sofa, a bedroom, and a bath room. The after deck house contains the principal entrance of the second-class, and their cabin and smoking room. The main deck contains four classes of accommodations entirely distinct from each other, which are from the bow as follows: *First,* the accommodations for sailors and stewards, as well as several rooms for accessories, etc. The *second,* which has a length of 105 meters (345 feet), is devoted at the forward end to the first-class smoking room; in the central part between the two funnels is the first-class dining saloon, which is 20 meters (65.6 feet) long and 14 meters (46 feet) wide, and can accommodate 250 passengers at the table at one time. Forward of the dining saloon are the compartments of the doctor and purser, opening directly upon the main entrance, which places these two functionaries immediately in touch with the passengers. In this part of the ship in various locations are found the galleys, bakeries, and other offices of the ship, grouped in the neighborhood of the after funnel. In wake of the machinery compartments are the quarters of the stokers and oilers, while the rear end of this section is occupied by the accommodations of the engineers. *Third,* a compartment containing the dining saloon of the second-class, which is immediately below the space occupied by the smoking room and cabin of this class. *Fourth,* the poop, containing the steering gear and a series of chambers devoted to refrigerating machinery and outfit.

The first 'tween decks is almost entirely devoted to accommodations of the first and second classes, the central part being reserved to passengers of the first-class, who are thus guaranteed the best results from the effects of pitching. At the center is a dining hall for children, a hair-dressing establishment, and a ladies' cabin. The passengers of the second-class occupy a group of state rooms situated aft of the engines, while at the extreme forward and aft ends of the ship are the accommodations for passengers of the third-class and the crew. At the forward end of this deck are found also a hospital, infirmary, and pharmacy.

The second 'tween decks contains at the forward and after end quarters for the passengers of the third-class, as well as those for the stokers and coal passers, and in the central part the engines and boilers. The third 'tween decks is occupied by cargo spaces, as well as by a part of the bunker arrangements. This summary description of the arrangements of the ship shows that the passengers of various classes are quite separated from each other.

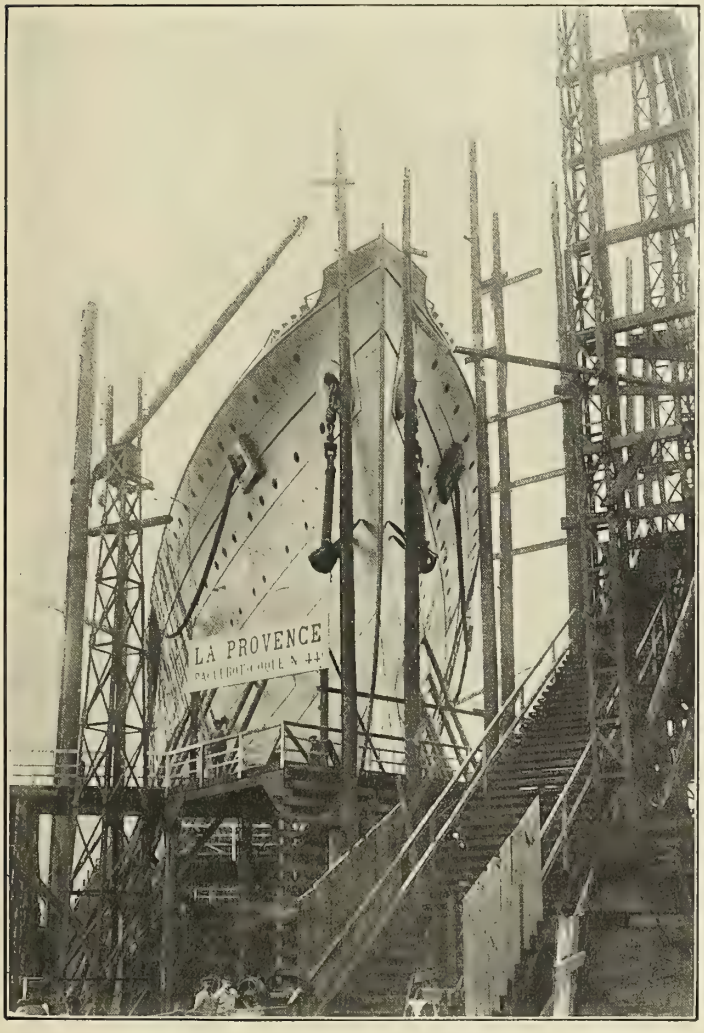
The arrangement of the parts of the ship reserved for passengers has been the object of especial care with regard to conditions of hygiene and ventilation. The decoration of the state rooms of the first- and second-classes is entirely in varnished mahogany. All of the first-class state rooms are furnished with electric lights, while certain state rooms, called "1-2 de luxe," as well as the apartments de luxe, have telephones, permitting the passengers to order without delay anything they may need. The decorations and drapings of the cabins, smoking rooms, etc., is of great luxuriousness. In addition to the other arrangements for the passengers, there is an elevator running through three decks and operated by an electric motor, while the installation on board of the wireless telegraph system permits the passengers to communicate with shore. All the apartments on the ship, without exception, are heated by steam, and the heat may be maintained in the separate radiators at a temperature of about 18 degrees Centigrade (62.4 degrees Fahrenheit). Certain of the principal quarters of the ship, in particular the first-class dining saloon, the ladies' cabin, and the apartments de luxe, are fitted in addition with electric fans.

The electric installation consists of four dynamos in two groups of two, each operated by steam turbines, and having a combined power equivalent to 300 Kw. They furnish current for a total of about 1,800 lamps. Current is also furnished by these dynamos to operate 49 large electric ventilating fans, four electric winches for hoisting the boats, and four electric capstans for handling the

LA PROVENCE AFLOAT.

anchors, as well as the small electric fans, etc. The refrigerating machinery is situated aft of the engines and is so designed as to maintain in the cold chamber a temperature of —5 degrees Centigrade (23 degrees Fahrenheit). It operates on the Linde system, using liquefied ammonia gas.

The main engines are two in number, triple expansion, with surface condensers, and have each four cylinders developing a total of 30,000 horsepower, with which a trial speed of 23 knots is anticipated. The boilers are twenty-one in number, of the cylindrical type, having diameters respectively of 5.2 and 4.9



BOW VIEW BEFORE THE LAUNCHING.

meters (17 and 16 feet), and operated at a pressure of 14 atmospheres (206 pounds per square inch). They are fitted with Howden system of forced draft. There are two funnels, having a diameter of 5.2 meters (17 feet), and a height above the grate bars of 35 meters (115 feet). All of the auxiliary machinery is operated by steam or electricity. The total number of items is 135, of which 75 are steam driven and 60 electrically driven.

La Provence, as with the other large passenger steamers of this line, is arranged for service as an auxiliary cruiser of the French navy whenever occasion calls for its being placed in that service.

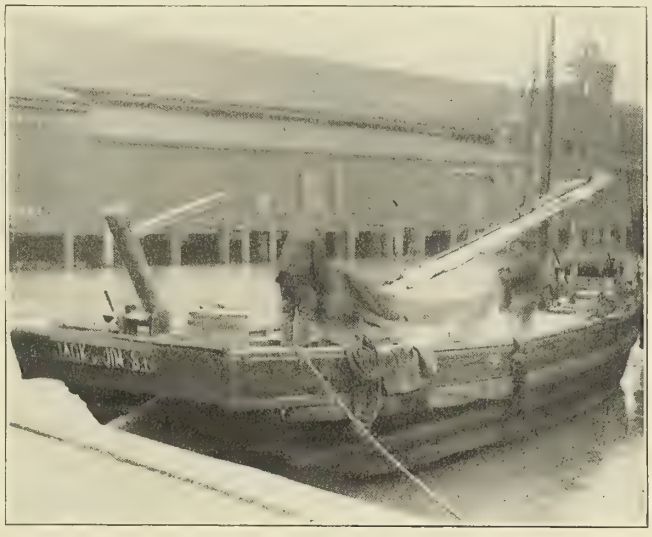
Mr. Andrew Olsen, formerly connected with the Townsend-Downey Shipbuilding Company, has formed the partnership of Olsen & Ainsworth, and has established a boat and launch business at Madison, Wis.

Mr. Charles A. C. Winther, for many years general superintendent of the Chapman Valve Manufacturing Company, has accepted the position of general superintendent of the Roe-Stephens Manufacturing Company, Detroit, Mich.

Foreign Types of Fishing Boats in San Francisco Bay.

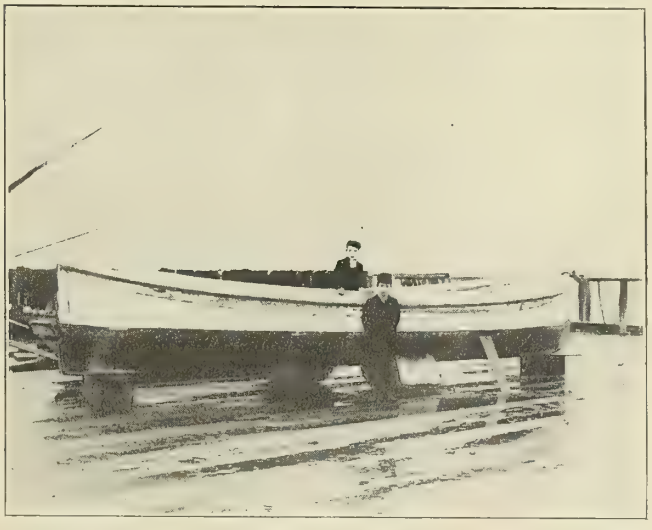
BY E. N. PERCY.

The accompanying illustrations show types of boats which are unique for this country. The first is a Chinese junk patterned after the peculiar architecture in vogue in the *Orient,* where no other design has obtained much place since the time of Confucius. There are about 200 of these boats in and around San Francisco Bay, which are used by the Chinese fishermen to carry shrimps and supplies between their fishing villages on the bay and the city of San Francisco. The sail is a rectangular sheet of



CHINESE JUNK ON SAN FRANCISCO BAY.

canvas stiffened by lateral strips of bamboo placed about 2 feet apart. It is hung by the middle from the top of the mast and has neither boom nor gaff, nor does it need either. These junks cannot beat at all well into the wind, hence with an adverse wind they find it necessary to make long detours in order to reach their



ITALIAN FISHING BOAT.

destination. The bow and stern are made of a sort of crude bulkhead built of planks, to which the side and bottom planking are fastened with wooden pegs. The planking varies in thickness from 1 inch to 1 1-2 inches, and is comprised of such nondescript material as can be found at hand, or bought for the lowest figure. The deck is boarded over and battened much as one would roof a chicken-house or wood-shed. In the center of the junk is a cockpit about 12 feet long by 6 feet wide, in which the cargo is carried. Except for this cockpit, the junk is decked fore-and-aft

and over the 18-inch space between the edge of the cockpit and the side of the boat. In rough or heavy weather a tarpaulin covers the entire hull.

The planking is supported by four constructions similar to transverse bulkheads, and these constitute the entire system of framing for the 30-foot length of the boat. The bottom is made nearly flat and has a small keel.

FISHERMEN'S WHARF.

On each end of the craft is a windlass of the very crudest description. The crew consists of six Chinamen, who live in a 5 by 5 hole in the stern. They steer with the tiller connected with the rudder through a rudder post. The rudder is about 3 feet square, dips 8 inches into the water, and is constructed of a single thickness of 1-2-inch pine boards. The cost of one of these craft complete is about $350. In building these boats the Chinamen use their time-honored custom of drawing both saw and

ANOTHER VIEW OF FISHERMEN'S WHARF.

plane toward them in the cutting stroke. Great care is necessary in docking the junks in order to avoid injuring their frail structures, as indeed a very small shock will suffice to cause an utter collapse.

In decided contrast with these Chinese junks are the staunch fishing boats used by the Italian fishermen on the bay. They are small, double-ended sail-boats of deep draft, carrying a lateen sail and equipped for emergency with a gas engine and propeller. The boats are decked over except for a small cockpit aft, and have a cozy cabin under the forward deck. The dimensions average 30 feet in length with a 6-foot beam, and a draft of from 2 to 3 feet. The Italians operating these craft go out into the Pacific for bass, halibut, and other deep-sea fish, and their fishing course extends over a wide area. They remain out in all kinds of weather for days at a time, and return only when they have obtained a heavy catch. The method of fishing seems to consist of placing buoys with lines and baited hooks, this requiring combined speed and endurance for effective results.

At the time of the sinking of the Pacific mail steamship *Rio de Janeiro* in the Golden Gate on the 22d of February, 1901,* these boats were of great assistance in recovering such of the bodies of the 131 who were lost as were not carried out to sea by the powerful tides. It was noted at the time that the men were extremely honest in the handling of such property as came into their hands, turning over to the authorities all the jewelry and merchandise of every description which they recovered. A recent trouble between two partners among these fishermen shows the childlike character of their nature. They decided that they could no longer remain in partnership, and proceeded to divide the property which was common to them. They cut in two with a knife all their seins and fish lines, as well as their chests, sails, and rigging, and then started to saw the boat in two in order that each might have half. This last operation was stopped by their friends, who showed them what a foolish thing they were trying to do.

The last two illustrations show "Fishermen's Wharf," where all of these boats land their fish and obtain supplies.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of July 10, 1905, the following percentage of completion of vessels building for the United States Navy:

				June 1	July 1.
BATTLESHIPS.					
Virginia	19	knots.	Newport News Co.	87.38	89.71
Nebraska	19	"	Moran Brothers Co.	72.4	75.
Georgia	19	"	Bath Iron Works	80.01	82.66
New Jersey	19	"	Fore River Shipbuilding Co.	84.8	86.2
Rhode Island	19	"	Fore River Shipbuilding Co.	87.6	88.8
Connecticut	18	"	Navy Yard, New York, N. Y.	77.73	80.74
Louisiana	18	"	Newport News Co.	77.55	80.79
Vermont	18	"	Fore River Shipbuilding Co.	51.1	53.6
Kansas	18	"	New York Shipbuilding Co.	54.	55.1
Minnesota	18	"	Newport News Co.	65.42	68.
Mississippi	17	"	Wm. Cramp and Sons	29.09	31.28
Idaho	17	"	Wm. Cramp and Sons	27.18	29.57
New Hampshire	18	"	New York Shipbuilding Co.	7.2	11.2
ARMORED CRUISERS.					
California	22	knots.	Union Iron Works	76.2	78.3
South Dakota	22	"	Union Iron Works	74.	76.1
Tennessee	22	"	William Cramp and Sons	75 73	79.4
Washington	22	"	New York Shipbuilding Co.	76.3	79.1
North Carolina	22	"	Newport News Co	6.03	9.14
Montana	22	"	Newport News Co	5.32	7.98
SEMI-ARMORED CRUISERS.					
St. Louis	22	knots.	Neafie and Levy Co.	65.3	67.4
Milwaukee	22	"	Union Iron Works	73.8	75.2
Charleston	22	"	Newport News Co.	94.98	97.
GUNBOATS.					
Dubuque	12	knots.	Gas Engine and Power Co.	99.4	100.
Paducah	12	"	Gas Engine and Power Co.	85.4	88.9
TRAINING SHIPS.					
Cumberland	Sails		Navy Yard, Boston	95.	95.
Intrepid	"		Navy Yard, Mare Island	97.5	97.5
TORPEDO BOATS.					
Goldsborough	30	knots.	Wolff and Zwicker	99.	99.
O'Brien	26	"	Lewis Nixon	99.	99.

*See Marine Engineering, page 127, April, 1901.

MOTOR BOATS.

BY DR. WILLIAM F. DURAND.

THE GAS ENGINE.—(*Continued.*)

Two-Cycle Engine: By a somewhat different mechanical arrangement of the engine it is found possible to condense the essentials of the cycle into two strokes instead of four, and thus to obtain one power stroke every revolution of the engine instead of every two revolutions, as in the four-cycle engine.

The operation of this engine may be explained by the aid of Fig. 7. The crank case, as here shown, is inclosed gas-tight and provides in effect a closed extension to the lower end of the cylinder. In *a* the piston is at the top of the stroke. During the preceding up stroke a fresh charge has been undergoing compression above the piston and at the instant shown in the figure is ready for firing. During the same up stroke another fresh charge has been drawn into the crank case through the inlet valve. At the instant shown in *a*, then, the gas has reached its

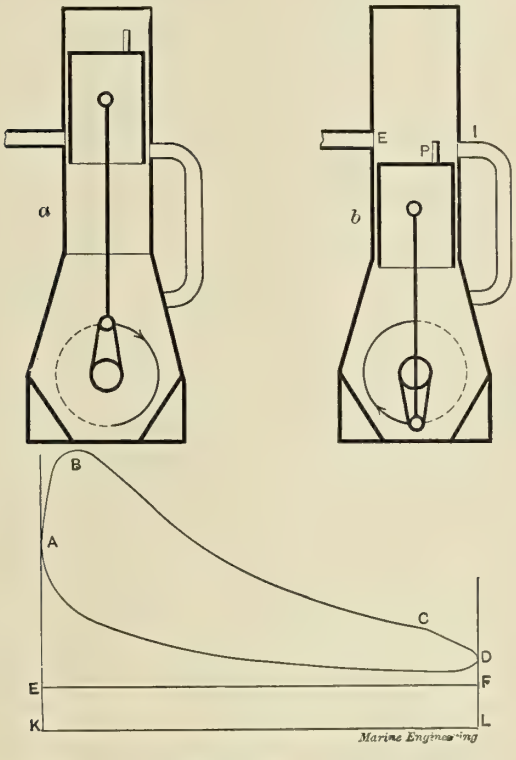


FIG. 7.—TWO-CYCLE ENGINE, WITH INDICATOR CARD.

highest compression pressure as indicated by the point *A* of the diagram. The charge is then fired, the pressure rushes up to *B* and the piston is urged along the down or power stroke under the action of the expanding gas in the same manner as with the four-cycle engine. This entire operation is indicated by the line *ABC* of the indicator card. Toward the end of the stroke the piston uncovers the exhaust passage *E*, Fig. 7*b*, exhaust begins, and the pressure drops as shown by the line *CD*. An instant later the piston uncovers likewise the inlet passage *I*, and the fresh gas which has been compressed in the crank case during the down stroke now finds relief by expansion into the cylinder through this passage. A deflecting plate *P* is commonly fitted on the piston, as shown, in order to deflect upward the incoming charge, and prevent its short-circuiting across direct to the exhaust passage. This deflection of the inflowing gas is also useful as a means of chasing or scavenging the spent gases out of the cylinder, and thus realizing substantially a cylinder full of fresh gas for each power stroke. These various operations are supposed to take place while the piston is moving slowly near the end of the stroke. As the piston begins to return it shuts off first the inlet and then the exhaust passage, the escape of the spent gases being then supposed to be complete. Actually, the events cannot be quite so accurately timed, and in practice either some little spent gas will still remain in the cylinder or some of the fresh charge will escape. However, with the charge in whatever condition it may be found at the closure of the exhaust passage, the piston continues its upward stroke, compressing the gas as shown by the line *DA* of the diagram, and thus preparing for the firing point at the beginning of a new cycle.

In analyzing the work of the cycle it will be clear, fixing our attention on the gas above the piston, that the work done *by* the gas on the down stroke is represented by the area *KABCDL*,

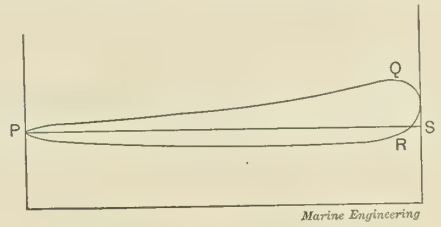


FIG. 8.—CRANK CASE DIAGRAM.

while that done *on* the gas during the up stroke is represented by *KADL*. The net work for the space above the piston is thus shown by the area *ABCD*. But this is not all. In the two-cycle engine with its closed crank case the pressure of the gas below the piston is not the same for each stroke. An indicator attached to the crank case would in fact show a diagram similar to Fig 8. The line *PQ* shows the compression in the crank case during the down stroke, reaching a maximum value at *Q*, just before the opening of the inlet passage as above described. The pressure then equalizes with that above the piston at a value slightly above the atmosphere, and then as the piston reverses its motion and begins its up stroke the pressure falls slightly below that of the atmosphere, where it remains during the stroke as shown by *RP*. The net work done *on* the gas in the crank case is therefore shown by the area *PQR*. The actual net work of the cycle will therefore be given by the difference between these two diagrams.

In Fig. 9 is shown the analysis of the pressures above and below the piston for each stroke after the manner of Fig. 6. Work done *on* the gas is shown by hatching inclined downward to the right, and work done *by* the gas by hatching inclined downward to the left. The singly hatched area *ABC* shows then the net work done by the gas from the beginning of the stroke up to the point *C*, while the singly hatched area from *C* to the end of the cycle shows

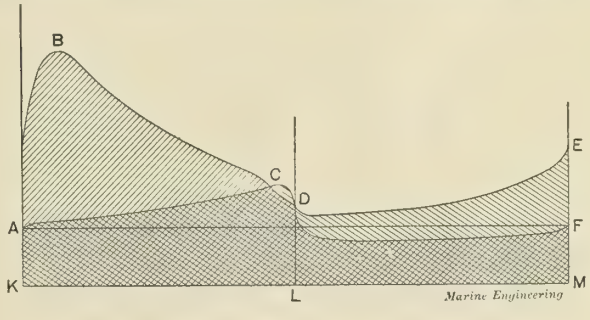


FIG 9.—DISTRIBUTION OF WORK IN TWO-CYCLE ENGINE.

the net work done *on* the gas during the rest of the cycle. That from *C* to *D* is done on the gas below the piston and that from *D* to *EF* is done on the gas above the piston while on the compression stroke.

Crank Effort. A further point of importance arises in connection with the turning effort on the crank and its relation to the crank angles when several engines are coupled to one shaft. Taking first the four-cycle engine and referring to Fig. 10*a*, let the strokes be numbered *1*, *2*, *3*, and *4* and indicated as shown, and let No. *3*, indicated by the heavy line, be the power stroke. Then it is

easily seen that in order to obtain a power stroke and turning effort every other stroke, a second cylinder (*b*) must be provided with its cycle displaced two strokes from that of (*a*). The strokes for two cycles may then be represented as in the diagram, the numbers referring solely to (*a*). Then remembering that the heavy line represents the power stroke in each engine, it will be seen that such stroke occurs once a revolution in one cylinder or the other, and hence that with this arrangement we obtain continuously one power stroke per revolution of the shaft. It is easily seen further that the cranks of both engines must lie in the

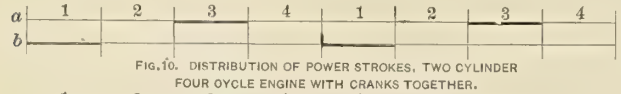


Fig. 10. Distribution of Power Strokes, Two Cylinder Four Cycle Engine with Cranks Together.

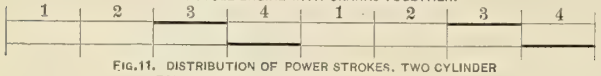


Fig. 11. Distribution of Power Strokes, Two Cylinder Four Cycle Engine with Cranks Opposite.

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same direction and not opposite, as might at first thought have been expected. With two cranks opposite, and using the same mode of representation, it is seen that the distribution of power strokes will be indicated by the diagram of Fig. 11. This shows power strokes or turning effort on two successive strokes, and then two strokes without power or turning effort. This is obviously a less desirable arrangement, so far as turning effort is concerned, than that with the cranks together as shown in Fig. 10. On the other hand, this same arrangement is much the more desirable so far as running balance is concerned. With the cranks together the engine by itself is entirely out of balance and such arrangement without counterbalance would be out of the question. It therefore becomes necessary in the two-cylinder engine either to fit counterbalance weights on the crank shaft, involving their extra weight and expense, or to adopt the arrangement of Fig. 11 with its irregular distribution of power strokes through the complete cycle. The latter is the arrangement usually adopted by builders of the two-cylinder four-cycle type of engine.

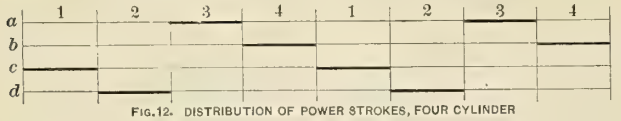

Fig. 12. Distribution of Power Strokes, Four Cylinder Four Cycle Engine with All Cranks in One Plane.

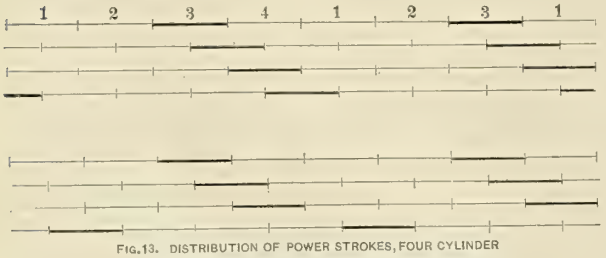

Fig. 13. Distribution of Power Strokes, Four Cylinder Four Cycle Engine with Cranks at 90 Degrees.

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In a similar manner it is seen that if we combine four cylinders successively one stroke apart, as indicated in Fig. 12, we shall obtain a power stroke in one cylinder or another for every stroke of the engine. It is also seen that the cranks will all lie in one plane, those for (*a*) and (*c*), for example, being up with their pistons at the top of the stroke when those for (*b*) and (*d*) are down with their pistons at the bottom of the stroke. So far as turning effort is concerned it is seen that this arrangement of cranks is equivalent to a single-cylinder steam engine with steam acting in the usual manner on both sides of the piston.

The question naturally arises regarding the distribution of power strokes in the case of four cranks at right angles successively around the circumference, as in the common type of four-cylinder marine steam engine. There might be several arrangements, of which two are indicated in Fig. 13. The successive strokes follow at intervals of one-half stroke between cylinders, corresponding to the 90 degree crank angle, and it is seen that the power strokes, indicated by the heavy lines, overlap in amounts varying with the arrangement, thus concentrating the power into a certain part of the entire cycle and leaving the remainder without turning effort. From this viewpoint, therefore, all such arrangements are inferior to that indicated in Fig. 12.

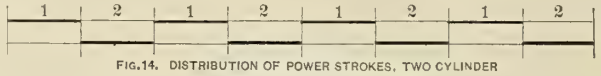

Fig. 14. Distribution of Power Strokes, Two Cylinder Two Cycle Engine with Cranks Opposite.

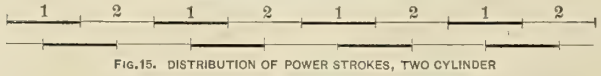

Fig. 15. Distribution of Power Strokes, Two Cylinder Two Cycle Engine with Cranks at 90 Degrees.

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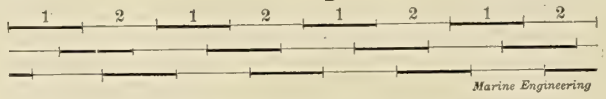

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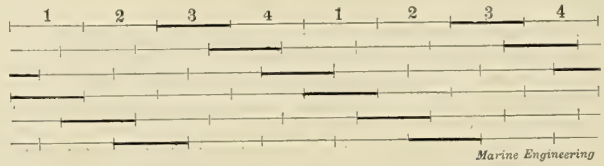
Fig. 16.—Distribution of Power Strokes, Three-Cylinder, Two-Cycle Engine, with Cranks at 120 Degrees.

With the two-cycle engine the combinations are similarly shown in Figs. 14, 15. In the former with cranks opposite the power strokes alternate between the two cylinders, so that on one or the other there is a power stroke for every stroke of the engine. This combination is therefore equivalent to the four-cylinder four-cycle arrangement indicated in Fig. 12, or to the common single-cylinder steam engine.

In Fig. 15 the arrangement with cranks at 90 degrees is shown. It is clear that here the power strokes overlap for a half stroke in one part of the cycle, leaving an equal period in another part without power or turning effort. The correct arrangement as regards turning effort is therefore that indicated by Fig. 14 with the cranks opposite.

It is also of interest to note that the equivalent of a two-cylinder steam engine with cranks at 90 degrees would require an eight-cylinder four-cycle or a four-cylinder two-cycle engine, the former being arranged in two groups of four cylinders each, and the latter in two groups of two cylinders each, all cranks in one group lying in the same plane, and the plane of the two groups lying at 90 degrees with each other.



Marine Engineering

Fig. 17.—Distribution of Power Strokes, Six-Cylinder Four-Cycle Engine, with Cranks at 120 Degrees.

Engines with three and with six cylinders, and with cranks at 120 degrees, are also found in the practice of the day. These permit of an excellent running balance and of a very satisfactory distribution of crank effort throughout the revolution. Various arrangements of power stroke are possible, but the most satisfactory are indicated in Figs. 16 and 17 respectively for the two- and four-cycle types.

General Comparison. In a general comparison between the two- and four-cycle engines the following points may receive consideration:

(*a*) For a given size of cylinder, length of stroke, and revolutions per minute, the two-cycle engine will give more power than the four-cycle. If the same amount of gas of the same

quality could be burned in each cylinder and if the energy developed could be used with the same efficiency, or in other words if the gas could be used with the same thermal and mechanical efficiency in both engines, then, since the two-cycle engine gives twice the number of power strokes in the same time, it is clear that it would develop twice the power of the four-cycle. Actually, however, the ratio is slightly less than two to one, varying with the special circumstances of the case. Under reasonable conditions, however, the two-cycle engine may be depended on to give from 75 to 80 or 85 percent of power in excess of the four-cycle for the same size and revolutions.

The failure of the two-cycle engine to develop under like conditions fully twice the power of the four-cycle is due chiefly to the difference in the control over the mixture in the cylinder. The waste gases are chased out of the cylinder in large measure by the incoming fresh gas, and this cannot be accomplished without some intermixture of the two, and this must result either in undue dilution of the charge if the exhaust is closed too soon or in the escape and wastage of part of the fresh gas if the closure of the exhaust is delayed. In the general case, therefore, the quality of the gas mixture is not under as definite control in the two-cycle as in the four-cycle engine, and this will react unfavorably on the amount of work which can be obtained per power stroke. During the non-power strokes the work involved in what may be termed handling and preparing the gas for the power stroke is presumably about the same in both types of engines.

As regards engine friction the two-cycle engine has somewhat the advantage over the four-cycle. In the former the friction of two strokes is charged against the power stroke, while in the latter the friction of four strokes must be thus charged. It results that in the latter as compared with the former the friction of two extra strokes must be charged against the one-power stroke of the complete cycle.

As a combined result of these various relations, the two-cycle engine shows, as above stated, an advantage in power developed of from 75 to 85 percent for the same size of cylinder and revolutions per minute.

It follows, of course, that for a given power required the two-cycle engine will show a marked saving in weight and space occupied as compared with the four-cycle type.

(*b*) With engines of the same general size and working under the same general conditions, the four-cycle type is found to be somewhat more economical in operation than the two-cycle. This means more power per cubic foot of gas, or per pound or gallon of fuel. This superiority is due primarily to the more perfect control over the quality of the mixture in the cylinder, and the more perfect thermal cycle for the gas in one case than in the other, and as discussed above in reference to the relation between the amounts of work in the two types of engine.

(*c*) Speed variation is somewhat more easily controlled with the four- than with the two-cycle engine. The various ways of effecting such control will be referred to at a later point, but in this general comparison it will be fair to point out that for widely varying speeds the four-cycle type will be found the better adapted. This again is due to the more definite character of the operations in the four-cycle type, and to the better control which may thus be exercised over the resultant charge of fresh gas.

(*d*) A more uniform turning moment may be obtained from the same number of cylinders working on the two-cycle plan than on the four-cycle plan. This will be readily seen by referring to the preceding discussion of power strokes and turning effort in multi-cylinder engines.

(*e*) A somewhat smaller flywheel is required with the same number of cylinders working on the two-cycle plan as compared with the four-cycle plan. This follows from the more uniform turning moment as noted in (*d*) above.

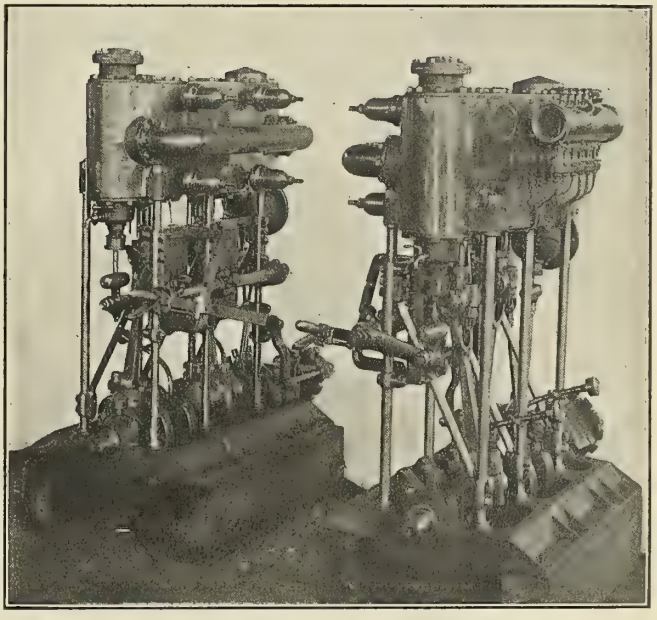
(*f*) The two-cycle engine more readily gives a combination of smooth turning moment and running balance. This will be readily seen by a detailed comparison of multi-cylinder engines using the graphic method of Figs. 10-17.

(*g*) High revolutions, if desired, are somewhat more readily realized and regularly maintained with the four-cycle than with the two-cycle type.

(*h*) The general trend of engineering opinion and practice justifies the conclusion that the four-cycle type is on the whole to be preferred for engines of any considerable size or power, or when economy of operation is of special importance, or where very high speeds of revolution are desired, and in general with reference to durability, reliability, and certainty of operation and control. On the other hand there is an undoubted field for the two-cycle engine in small sizes and where light weight, compactness, simplicity, and low cost of construction are considerations of special importance.

Having thus considered the general character of these two types of marine internal combustion motors, we shall, in the next chapter, take a nearer view of such motors as they are actually found in the leading practice of the day.

(To be continued.)



Compound Engine of the Shallow-Draft Steamer Macuspana.

We show herewith a photograph of the compound engine of the *Macuspana,* which boat was described in Marine Engineering for November, 1904, on page 518. There are two of these engines, operating twin screws and having cylinders 4 1-2 and 9 inches in diameter with a stroke of 6 inches. The piping is arranged so that the engines may be worked either together or independently, the total horsepower of the two engines being about 50. The crank shafts, connecting rods, valve, eccentric, and piston rods are all of the best open-hearth mild steel, while crossheads, "brasses," receiver pipe, relief valve, and stuffing glands are of naval gun-metal. The reversing gear is of the spiral type, the spiral arrangement being located on the crank shaft at the after end of the engines. The high-pressure valves are operated from a rocker shaft, as shown. The cylinders are covered with polished brass lagging. Boat and engines are from the works of the Racine Boat Manufacturing Company, at Muskegon, Mich.

Mr. Ralph M. Parsons, of Chicago, has purchased the interest of his partner, Mr. John G. Kreer, and will continue the business of building shallow-draft boats, etc. Mr. Kreer has joined Mr. D. B. Southard, and will take the Chicago agency for several well-known launch, gas engine, and other concerns.

At page 242 of our issue for June appeared an article translated for us, which, we neglected to state, was published originally in *Schiffbau.*

The Steamship Crown of Castile.

BY BENJAMIN TAYLOR.

The new steamer *Crown of Castile,* built by David and William Henderson and Company, Limited, Glasgow, for the West Indian "Direct Line" of Prentice, Service and Henderson, of the same city, is an excellent example of a high-class cargo vessel, with passenger accommodation. She has been designed and constructed with the object of providing the best possible facilities for handling cargo. The principal dimensions of the vessel are: length, 400 feet; beam, 53 feet 2 1-2 inches; and depth, 28 feet 4 inches; she has a carrying capacity of 10,000 tons measurement and 7,200 dead weight. The *Crown of Castile* is propelled by a set of triple-expansion engines, constructed by Messrs. Henderson, and having cylinders 27, 46 and 76 inches in diameter, with a piston stroke of 48 inches; these are supplied with steam at 180 pounds pressure by four single-ended multitubular boilers 15 feet 9 inches in diameter and 11 feet long, each having three corrugated furnaces 3 feet 11 inches in diameter. In the engine room there is a complete outfit of auxiliary machinery including Weir's feed pump, Weir's evaporator of 20 tons capacity, electric lighting plant, and steam steering gear, the latter supplied by Caldwell & Company, of Glasgow.

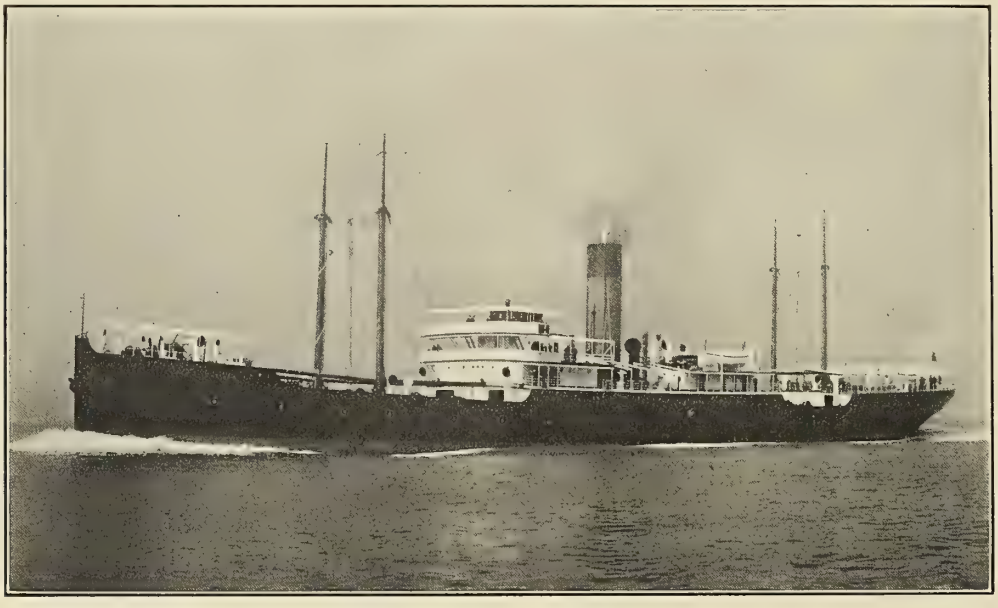
A distinctive feature of the *Crown of Castile* is her rig and cargo gear, which consists of four pole masts placed in pairs about 24 feet apart athwartships, each carrying two derricks, one of which works forward and one aft. In this way a much greater overside swing of derrick may be obtained than with single masts, and cargo can be landed in the outer of a double row of barges lying alongside, or where necessary, the cargo can be landed direct into railway cars. The steam winches for working these derricks are nine in number, extra heavy, with large bearings, and are of Messrs. Henderson's special construction, having cylinders 7 inches in diameter by 12 inches stroke, and short barrels 22 inches in diameter for quick hoisting with wire rope. Each derrick is capable of working loads of ten tons, while a special heavy derrick is fitted capable of dealing with loads of thirty tons. When loading the vessel prior to her departure from the Clyde this gear was well tried and found to work perfectly, and the loading was done in record time.

Another feature of this steamer is the superior accommodation for a number of first-class passengers, which is fitted in a large steel house at the fore end of the bridge deck. This comprises a large airy saloon tastefully fitted in light polished oak, in which dining accommodation is provided for fourteen persons. Off this access is given to six well ventilated two-berth state rooms, and in the same house are placed the bath rooms, steward's room, pantries, and store rooms. Over this house, and communicating with it by an inside stair, is the captain's room, and a comfortable smoke-room for passengers.

The ship's officers and engineers are accommodated in large rooms on either side of the engine casing at the after end of the bridge deck. This accommodation is fitted throughout with electric lights and bells.

On April 15, having completed loading at Glasgow, this vessel proceeded down the Clyde for speed trials, when a mean speed of 12.8 knots on the measured mile was obtained, everything working in a most satisfactory manner. After picking up a number of passengers she proceeded on her first voyage to the West Indies

The *Crown of Castile* will shortly be followed from the yard of the same builders by her sister ship, the *Crown of Aragon,* and the two will form a valuable addition to the regular service of the "Direct Line" between the United Kingdom and West Indian ports.



THE CROWN OF CASTILE ON TRIAL TRIP.

Paddle-Wheel Yachts.

According to the tables given in *Manning's Yacht Registry,* there are left in the United States at the present time only four steam yachts operated by paddle-wheels. Of these four, two are unrigged, and the other two, which we illustrate herewith, are both rigged as two-masted schooners. The larger of the two, which was the *Clermont,* belonging to the estate of A. Van Santvoord, of New York, measures 175 feet length over all, 165 feet on the water-line, has a beam of 25 feet 6 inches, a depth of 10 feet 5 inches, and a draft of 5 feet 6 inches. Her gross tonnage is 299 and net 203. Designed by Mr. Van Santvoord, and built by H. Lawrence, of Greenpoint, New York, this yacht was launched in March, 1892. She is propelled by a surface condensing beam engine, having one cylinder 40 inches in diameter with a 72-inch stroke, and operated by steam furnished by a flue and return-tube boiler, both boiler and engine having been constructed by the W. & A. Fletcher Company, Hoboken, N. J.

This yacht has recently been purchased by Mr. Charles G. Gates, of New York, and renamed *Charmary.*

The other yacht which we illustrate is the *Turtle,* belonging to Mr. Arthur Amory, of Boston, Mass. She measures 89 feet 2 inches over all with a water-line of 80 feet. The beam is 19 feet

PADDLE-WHEEL YACHT TURTLE.

1 1-4 inches; depth, 5 feet 9 inches; and draft, 3 feet 4 inches. Her tonnage is 37.5 gross and 23.6 net. She was designed and built by Allan Hay, of Lynn, Mass., in 1889. She is propelled by a two-cylinder compound oscillating engine, the cylinders measuring 9 and 17 inches respectively in diameter with a stroke of 20 inches, this engine being built and installed in 1893 by George E. Whitney. Steam is furnished by an Almy water-tube boiler installed in 1898.

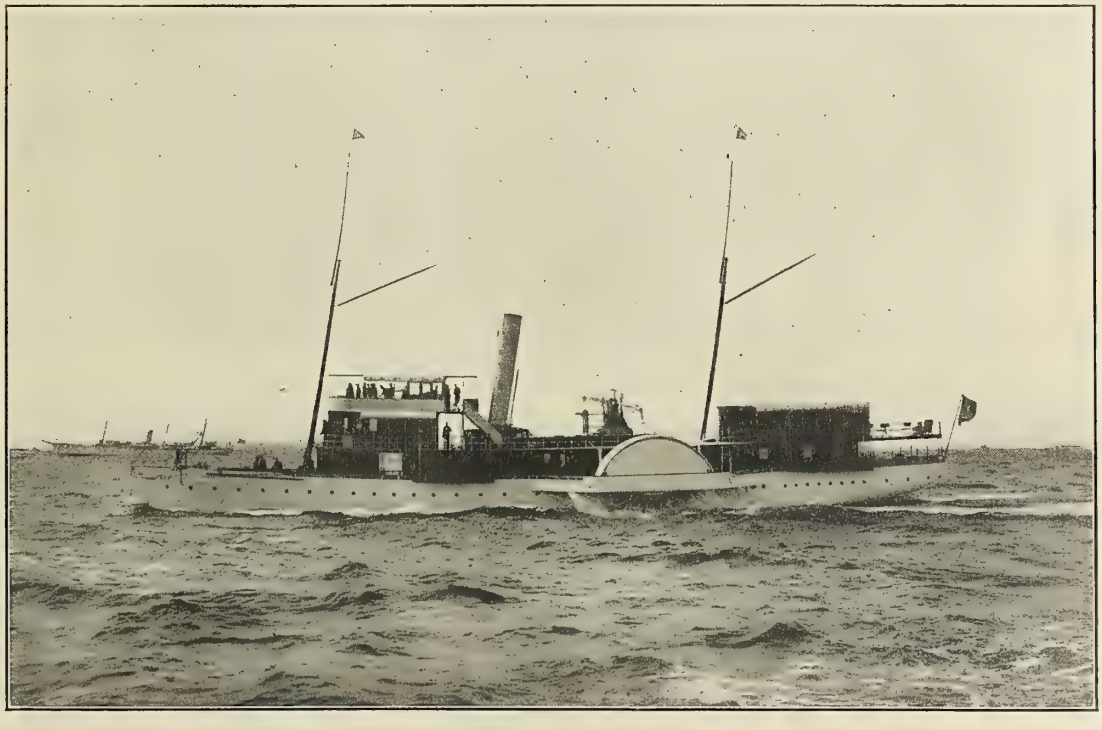
The two photographs were taken by Mr. N. L. Stebbins, of Boston.

Log Book of a Whaler, 1834-1837.

Extracts.

Mr. Andrew Snow, Jr., New Bedford, Mass., recently left at the office of Marine Engineering, for examination, a very interesting old log book. It is the ordinary rough log, about 13 by 20 inches in size. The paper has been roughly ruled by pen and ink, and the log itself is bound in heavy canvas. It describes the voyage of "ship *Barclays* on a whaling voyage to the Pacific ocean, Captain Henry Carttel, master."

Whenever a whale is caught, a crude impression of a picture of



YACHT CHARMARY, FORMERLY CLERMONT.

a whale is stamped on the page, evidently from a wooden block, the surface of which has been covered with ink. When a whale is chased but lost, a picture is given of the whale "flukes up"—that is, only the tail showing. The boat capturing the whale is given credit on the margin of the log, and the amount of oil is also recorded. Thus: "starboard bow boat, 65 bbls." As shown by the dates, the voyage began September 13, 1834, and ended September 27, 1837. The following extracts from the log give an idea of the whole, but leave out much detail of the itinerary around Cape Horn and among the islands of the Southern Pacific ocean.

The first entry is dated Sep. the 13th 1834

Saturday on board; Now, Lying at anchor, Bedford Harbor below palmers Is 5 fathoms of Water first part (of the day) of these 24 hours strong Breezes from the N W the weather fine most of the Crew on Board employed Ships Duty mid part (of the day) light airs from the N W Latt part a fine Breeze from the N at 5 oclock the Pilot come on board Commensed heaving a head at six oclock Broke ground and Bid a Due to the Land We all so much admire but with the hopes of a Short Voyage we set all sail at 9 oclock the pilot left us steered out S W at 11 oclock the wind shifted to the East from that to S E we steering to the S W at 12 oclock to Gayhead light House Bore E 1-2 N Dist 8 Miles the No mans Land Bore E S E—saw number of Vesels steering different Coursees so Ends this day with unpleasant Fealings . . . Sweet Home

. . . . . .

Monday Oct the 6th

Commenseed with fine Weather and light Winds from the South we with all sails set one Brig insight at 2 oclock Lowered our boats to exersize the Crew which was very necesury at Supper While in the act of Shareing the vittals forward one of the Crew began to fight with some of the Green hands it being the third time we put him in Rigging Not intending to flay him, but his Sausy tung causeed him a few stripes with fore parts of a smal eadline affter wich he acknowledge that he was to blame we then let him goe forward where he made nomber threats this promising youths name is Bradford Tiafford . . . Mid part light airs from south the Black Smiths very sausy he being the worse for Rum Latt Part calmer lowered the Boats and chaseed Grampass for Whales

. . . . . .

The Remarks on boad wednesday Oct the 8th

This day begins with strong Winds at N E and squaly we with all sail set steering to the ese all Hands Emp in Ships duty pasta Schooner steering to the N W Mid part Dubble Reefed the topsails took in the jib and spanker Latt Part much the same accomed with bad sea one watch below the rest Employed in Domestic duty Nothing to be seen but the wide Ocean our old Rigging parts very often it is not other wise to be Expected so ends this long and Dismal day in hopes of a fare one

. . . . . .

Remarks on Sunday Oct the 12th

begins with fine weather and strong winds all hands Emp at 3 oclock saw a Shoal of Sperm Whales a Going to the S E lowered our Boats and got one of them 30 bbls at 5 oclock took him a longside took in sail and lay by for the Night Mid Part employed in Geting Redy for Cuting latt Part at day light commensed Cuting at 9 oclock finshed wind to the N E the weather fine Com Boiling

. . . . . .

November Monday the 3th Cape Verds I

First part of this day strong traids at E N E all set steering S by W at 2 oclock saw the Iland of saint Nicholas Bairing S by W the east point by Compas dist 50 M at sunset it bore the same dist 30 Miles and st Anthony south point bore West Mid part took in the light sails steered S by w at 12 oclock the Iland of Saint Nicholas bore N W by W dist 20 miles Latt Part at daylight saw st Jago ahead steered for it at 9 o'clock saw the Isls of May Run down the west side of it within 8 miles saw a ship and schooner abeating up to the harbor so ends (the day) with south point bairing N E dist 20 miles

. . . . . .

December Thursday the 25th

First part agail from the Eastward dubble reef the topsails Mid Part calms and light airs Latt part a Fine Breeze from the N W set all sail steered S E the weather fine and clear saw a Number of finbacks the Water very Green thus ends

. . . . . .

(Neither Christmas nor New Years are observed in any way according to the records, and evidently there was no opportunity for observing New Years, as "Heavy gails" lasted for days as the ship passed round Cape Horn. Weeks passed and life was very monotonous, and according to the log no whales were either caught or seen.)

. . . . . .

Callao Wednesday February the 18th

Begins with fine weather light winds from the S we steering North for the Iland of Lorenzo at 1 oClock saw it Bairing E N E Dist 22 M at Sunset it Bore S E dist 7 Miles Bent the Chains Got Ready for Anchoring. Mid Part light airs and Calms thick Fog at 11 Oclock Came to anchor in 10 Fathoms of Water 3 Miles Below the Shiping Latt Part at Daylight took our Anchor and Beat up to the Shiping with alight Breeze from the S by 8 oClock we Anchored In the Harbor of Callao in 7 fathoms water the West Casttle Bairing S W by S dist one Mile hear we found the ship *Barclay* off Nantucket with 1300 bbls Bound Home three Men of War and a Number of Merchantmen at 10 oclock Sent on Shore a Raft of Cask for Water thus Ends all Hands Employed

. . . . . .

Saw Whales for the First time this side of the iland and Got None Is this Not hard for the Poor. April Friday the 17th

Begins with strong winds from the S E we steer S W by S at three Oclock saw a shoal of Sperm Whales a Goeing to the windward quick Lowered the Boats and Chaseed them till Sunset and then Come on Board down in the Mouth Mid Part lay with the Main top sail to the mast Latt Part steered S W at 9 Oclock Saw 2 Ships a head Run for the one of them a Cutting at 12 oclock saw a Whale Breech to leward of them ran for it thus Ends this day

. . . . . .

(The log continues for weeks and weeks, describing each day's doings of the voyage, and the occasional picture of the "flukes" of a whale show that a number were chased but lost. Occasionally there is a crude picture of a whale stamped against a day, showing that one had been caught.)

. . . . . .

October Sunday the 25th

Begins with strong breezes We Employed a Cuting In the side Whale (which was caught the day before) at 2 finished and steered our Course West at 4 Oclock saw more whales at 5 lowered the boats from boath Ships struck one Whale and Got him took him to the *Ann* (a Nantucket ship which was in company with the *Barclays*) Mid Part lay by Latter Part the *An* finished Cuting Steered of W S W Boath Ships at 10 oclock saw More Whales Lowered the Boats from boath Ships Struck one through our Ship and Got him at 12 oclock took him a longside thus Ends the *An* in Chase of the Rest (the stamp shows that the St. Boat caught a 60 bbl whale and the S Boat at 40 bbl. whale.)

. . . . . .

November Sunday the 22 Runaways

These 24 Hours begins with fine weather and strong breezes from the S E Moast of the Crew on Liberty Mid Part Calms Betwixt 8 and 9 oclock While the Capt Was out of the ship the Third mate George Coffin Took the Boat from a Longside with out Liberty and Went on Shore Takeing with him all of his Cloathe with him and One of the Crew by the name of George W.

Crocker this is Not unexpected for it has long ben talked of by Coffin Mid Part Calms Latte Part the Winds Light one Watch on liberty sent the Natives in Search of the Sweet Deserters thus Ends this and no Tidings of them and I hope there never will be again of the Third mate

. . . . . .

November Monday the 23th More Deserters

now begins with Fine Weather and light Breezes from West one Watch on Shore on Liberty at 7 Oclock the Liberty men Come of with the Exceptions of David Dupar and Edward Mich who has Deserted the Ship Mid Part Calms Latter Part light Westerly Winds one Watch on Shore; Got of 10 bbls of potatoes thus Ends and (no?) News of the 4 deserters as yet

. . . . . .

April Friday 29th Notice this

This begins with Strong Breezes from the E N E We Steering to the S E all sails Set Nothing insight at 3 oclock took the Winds from the E tacked Ship to the N N E Mid Part Winds at S E steered up E N E Latter much the same at 8 oclock the Capt sent the steward forward to Call the Men aft or one of them to se their Meat Weighed; but their reply was that they would not come, this was told the Capt, he immediately Called to them to come aft and repeated it three times and then went after them and took a Broom at one of the Blacks they all refused to *go* aft but sent one their complaint was that one pound and 1-4 of Meat was not enough and were very insolent and made their threats they Now went Forward not wishing to se their weight of meat; the said Black was insolent to the Capt when Coming forward but was called to Go aft again his reply was that he would *not* and fled for the fore Castle while Getting him up one of the Men Henry Ketchum came at the Gangway and interfered and Challenged the Capt and struck him at this the Capt took hold of him and dropped his wepon the Fellow took it up and maid an atempt to strike the Capt with it from this he was told to go Aft but refused and went Down the Fore Castle took a sheath kife and said he would kil the first Man that went Down but afterward delivered him self up to be put in Irons where now remains in the Run Thus Ends in peace

. . . . . .

On "September Monday the 25th 1837" the ship was within two days of Buzzard's Bay on her return home. According to the log this day:

Begins with fine weather Calms saw a Number of whales Mid Part light airs from the N E all sails set steering by the Wind to the N N W Latter part much the same saw one ship and 2 brigs steering to the N W thus ends with light airs from the east

September Tuesday the 26 1837

this commensed with fine pleasant weath and light breezes from the S E and South all sails set saw a number of whales and Finbacks Mid Part strong Breezes at S W steered north N by W and North at 2 oclock Sounded Got 30 fathoms of Water hove 2 with the Main yard aback north N N W at 9 oclock the said George Wingate (to whom the log makes no reference under previous dates) Departed from this Life; Latter Part at 4 steered of N E by E saw a number of small vessels at 8 oclock came to wind with the Main yard aback and Commited the said Corps to the deep at half past 8 steered again at 9 oclock took a Pilot Block I Bairing W S W Dist 25 Miles steered off again N E at 12 oclock Dumpling Light house bore N E Dist 5 Miles thus Ends this Joyful Day

September Wednesday the 27th

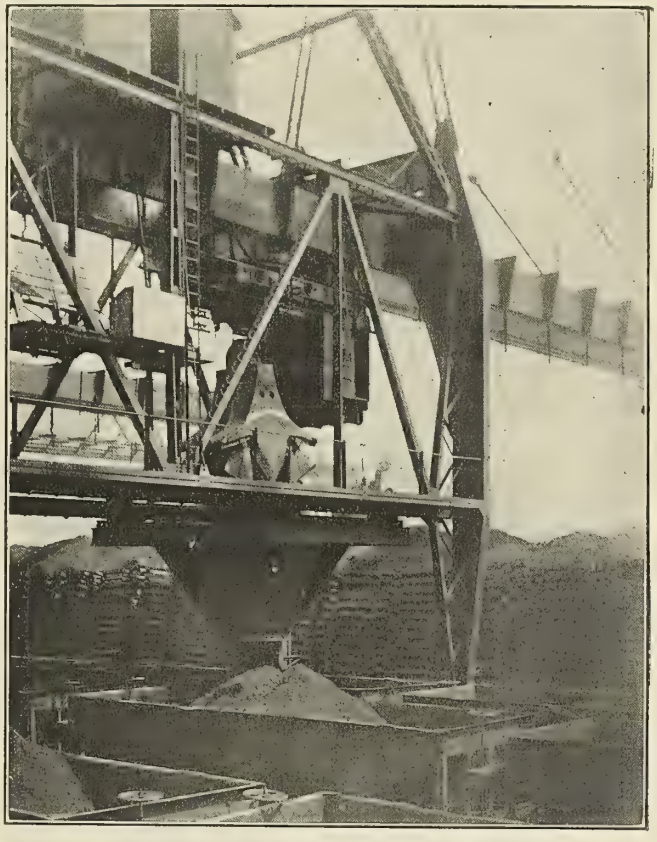
Begins with strong Breezes from the S W at one oclock passed the lighthouse at 2 Came to New Bedford in the Inner Roads Furled the sails thus Ends a voage that has been full of errors from the begining to the End

---

A record of the voyages of the ship *Barclays* follows:

Sailed.	Returned.	Ocean.	Captain.	Sperm Oil. Barrels.	Whale Oil. Barrels.
Aug., 1797..	June, 1799..	Pacific	Griffin Barney....	700	500*
Oct., 1799..	June, 1801..	"	" "	....	....
May, 1803..	Nov,, 1804..	Indian.....	Randall.....	1,200	....
May, 1809..	May, 1811..	Pacific	Gideon Randall..	2,000	....
Nov., 1811..	Mar., 1814..	"	" "	1,800	....
July, 1815..	Nov., 1817..	"	Coffin	1,950	....
Jan., 1818..	Oct., 1820..	"	"	1,600	....
April, 1821..	April, 1824..	Japan.....	Glover.....	1,600	...
June, 1824..	April, 1825..	Brazil	Peter Coffin.....	160	1,600
Aug., 1827..	Oct., 1830..	Pacific.....	Sam Barrett.....	1,858	....
April, 1831..	June, 1834..	"	Alex. Coffin, 2d...	1,200	....
Sept., 1834..	Sept., 1837..	"	Henry Cottle.....	1,362	....
April, 1838..	April, 1840..	Indian.....	Swain.....	165	1,939
July, 1840..	Mar., 1843..	"	Briggs	191	1,685[a]
Dec., 1843..	July, 1844..	Pacific.....	Grinnell.....	....	....
July, 1844..	Jan., 1850..	"	Mann.....	850	....
May, 1850..	April, 1852..	Atlantic and Indian.	Taber.....	994	....
July, 1852..	April, 1854..	Atlantic....	A. P. Taber.....	728	365[b]
Aug., 1854..	Aug., 1857..	Atlantic and Indian.	A. J. Fuller.....	410	1,016[c]
				18,768	5,605

* Also 21,000 seal skins.
[a] Also 13,200 pounds of whalebone; [b] 2,400 pounds; and [c] 2,100 pounds.



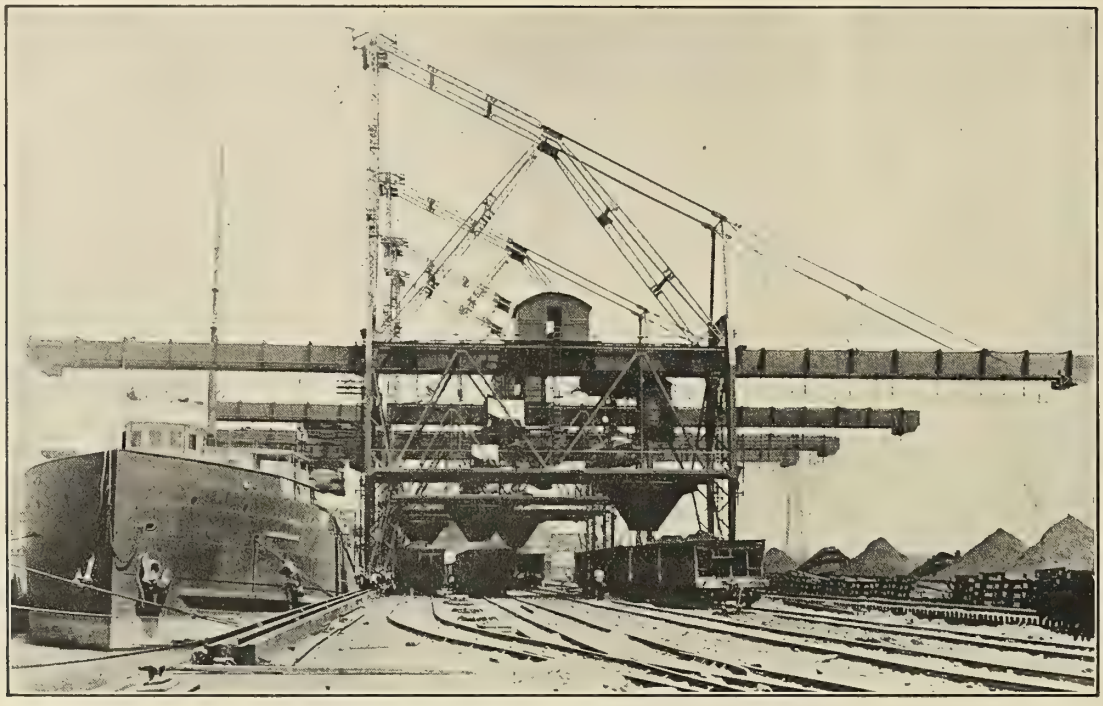
TRANSFERRING ORE DIRECT TO RAILROAD CARS.

(Copyright, 1904, Waldon Fawcett.)

ELECTRICALLY-OPERATED ORE UNLOADING MACHINES.

BY WALDON FAWCETT.

There has recently been installed on the docks of the Pittsburg and Conneaut Dock Company, at Conneaut, O.—leading terminal of the Steel Corporation fleet on the Great Lakes—an ore unloading and storage plant which is made up of new types of apparatus radically different in many important essentials from anything heretofore devised for the transference of bulk cargo from vessels to railroad cars or storage bins. The plant consists of four electrically-operated direct unloaders or "fast plants," and, working in conjunction with these, an electric bridge tramway.

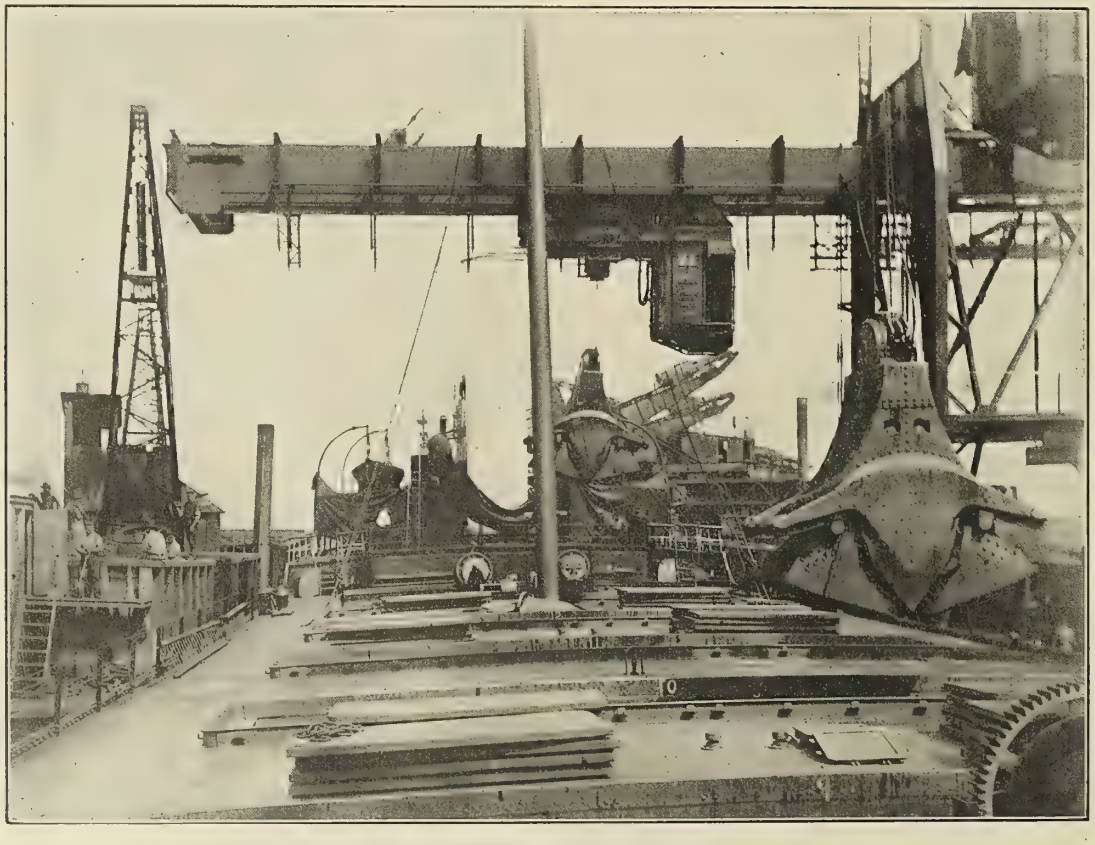


DOCK VIEW OF ELECTRIC ORE-UNLOADING MACHINES.

(Copyright, 1904, Waldon Fawcett.)

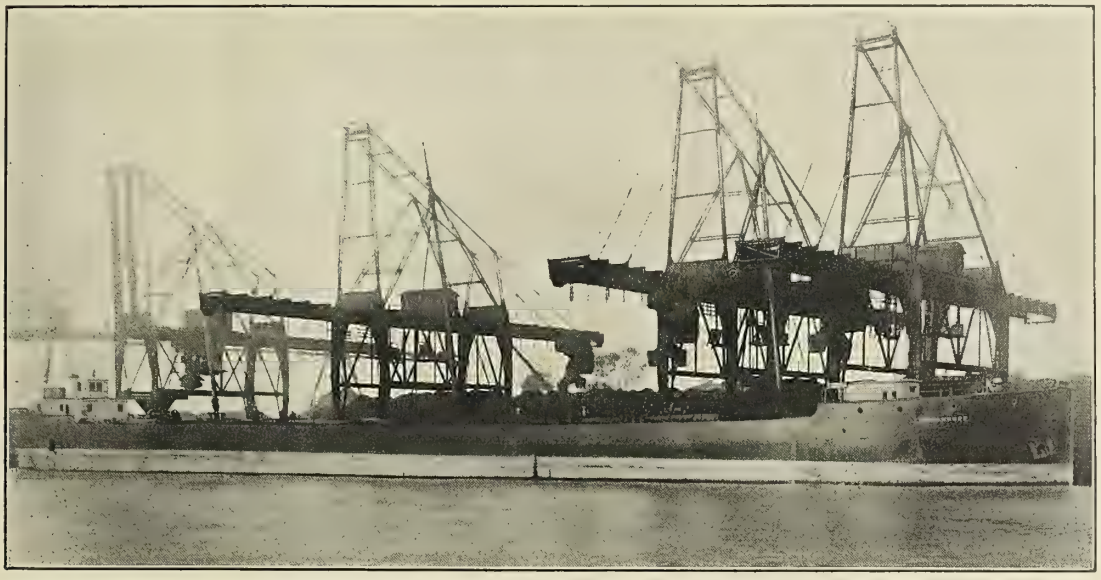
Each direct unloader consists of a portal pier spanning four railway tracks with a distance center to center of pier legs of 62 feet 10 inches, arranged with a raisable apron 59 feet 6 inches long at the front or water end and a fixed cantilever 67 feet 9 inches long at the rear end. Each direct unloader is equipped with an electric man-trolley capable of handling a fully-loaded, 5-ton, 2-rope patent ore grab-bucket at a hoisting speed of 300 feet per minute and a traveling speed of 800 to 900 feet per minute. The speed of each direct unloader along its track is from 50 to 75 feet per minute.

For the above operations each electric man-trolley is equipped with two 150-horsepower special type R (Elwell-Parker Electric Company) motors for hoisting, and one 100-horsepower motor of the same type for racking. Each direct unloader is equipped with



RAISING FULL BUCKET OUT OF SHIP'S HOLD.

(Copyright, 1904, Waldon Fawcett.)



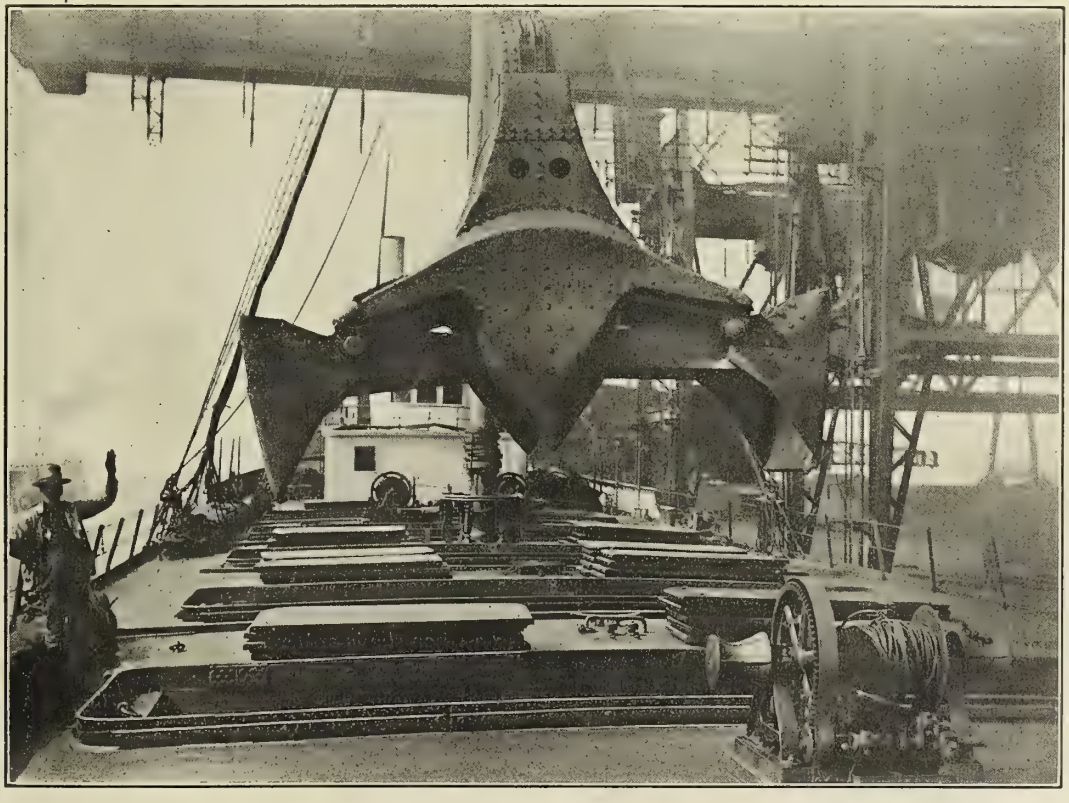
THREE MACHINES AT WORK ON STEAMER ALFRED KRUPP.

(Copyright, 1904, Waldon Fawcett.)

one 75-horsepower motor for moving the same and raising and lowering the apron. Each direct unloader requires only one man for its operation, this man riding in a cage attached to the trolley, from which position he controls the different functions of operation such as rotating, closing, opening, hoisting, and lowering of the bucket, the travel of the trolley, the travel of the crane, and the raising and lowering of the apron.

In the unloading from vessel the ore may be put into railway trucks on any of the four tracks under the pier of the crane or on the one track under the fixed cantilever arm, or into the trench under this fixed cantilever arm. For guiding the ore into the railway trucks a movable hopper is provided. The ore deposited in the trench is picked up by the electric bridge tramway and put into storage. This tramway is also capable of taking the ore from storage and putting it into the railway cars which run under the portal pier of the crane.

The electric bridge tramway consists of one span 250 feet 3 inches in length and two cantilevers, one supported at one end by a portal pier straddling two railway tracks and being 161 feet 8 inches long, while the other is supported by an A-frame shear leg and is 157 feet 9 inches long. The bridge tramway is equipped with a patent electric man-trolley capable of handling a fully loaded 7-ton, 2-rope patent ore grab-bucket at a hoisting speed of 225 feet per minute and a traveling speed along the bridge tramway of from 900 to 1,000 feet per minute. The speed of travel of the bridge tramway with full load is from 50 to 75 feet per



OPEN ORE BUCKET ABOUT TO DESCEND FOR A LOAD.

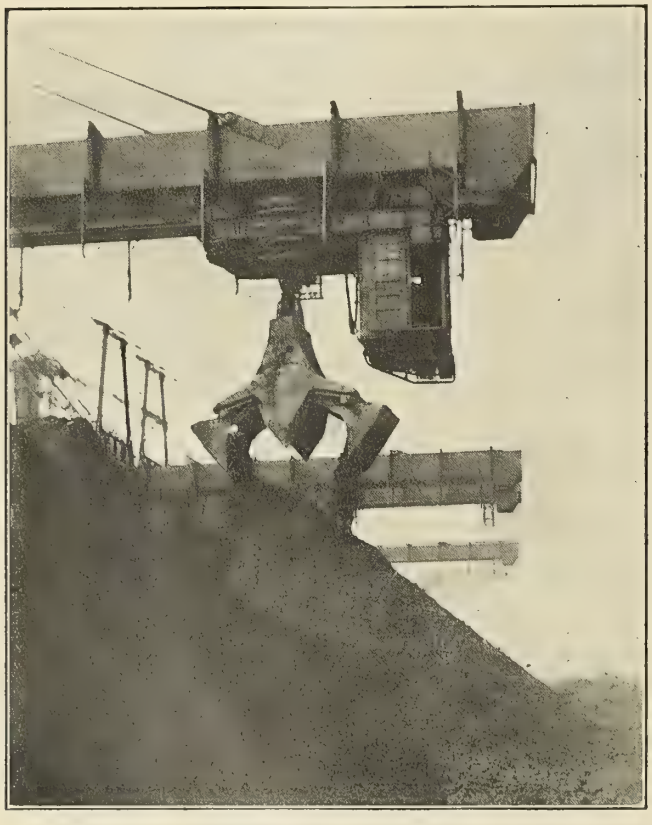
(Copyright, 1904, Waldon Fawcett.)

END VIEW OF NEW MACHINES, ON SIDE OF QUAY.

(Copyright, 1904, Waldon Fawcett.)

minute. For these operations the electric man-trolley is equipped with two 150-horsepower motors of the type above described for hoisting and two 75-horsepower motors for racking. In addition there is one 150-horsepower motor for moving the whole bridge upon its tracks.

The plant has been in operation but a comparatively short time, but has up to date handled iron ore at an average capacity per direct unloader of about 180 tons per hour. The buckets have averaged about 41 trips per hour for the entire time. A few weeks ago there was made at Conneaut a record on the four direct unloaders which surpassed any previously made by any plant anywhere in the world in so far as labor cost is concerned. This showing was made in transferring a cargo from the large steamer *Augustus B. Wolvin.* The cargo was 9,306 gross tons of very sticky ore. The total time of unloading was 15 hours and 30 minutes, or an aggregate of 62 hours on the basis of one machine. The speed of unloading was 168 net tons of ore per hour per machine. Fifteen shovelers worked for three and one-half hours in cleaning up the ore in the hold of the vessel, and this was all the labor used during the unloading except that of the four operators, one on each machine, and one oiler, who were employed during the whole time. There was a high stock pile to contend with, and the fact that some of the ore had to be put upon the dock on account of a lack of cars makes the showing all the more remarkable.



DISCHARGING ORE ON STOCK PILE.

(Copyright, 1904, Waldon Fawcett.)

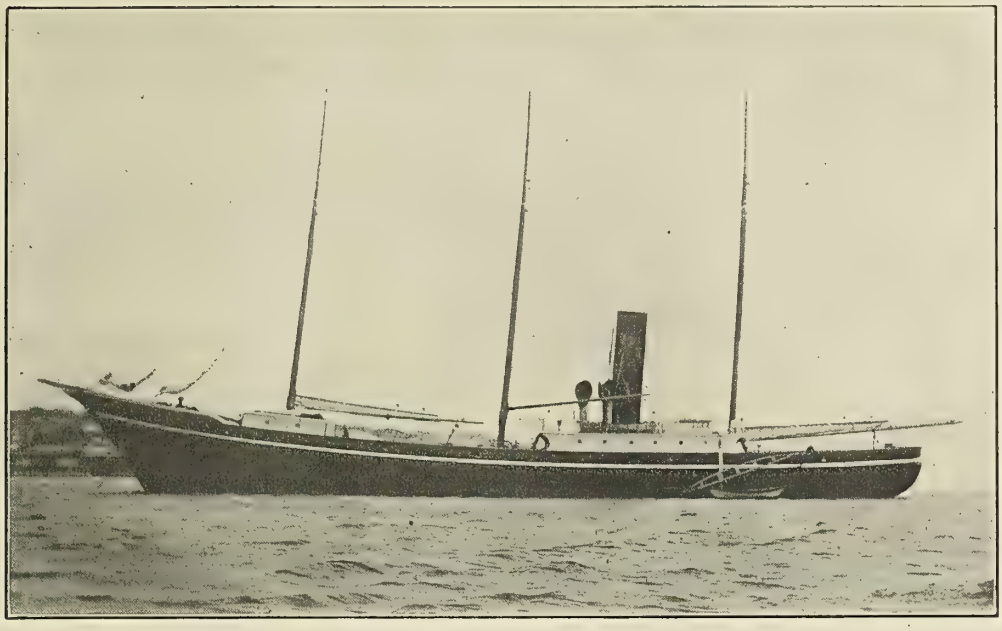
The 7-ton bridge has made an equally creditable showing. On a record of twenty-five days this apparatus handled an average of 296 tons of ore per hour, taken from the trench or pit and delivered midway on the main span of bridge. During the making of this record the bucket averaged 6.27 tons of ore per load and ran in some instances as high as 8.3 tons of ore per bucket. All this ore was handled by one man, without any helpers at either the receiving or discharging end. The above described apparatus, both direct unloaders and bridge tramway, are the invention of the engineers of the Brown Hoisting Machinery Company, of Cleveland, O.

PROPELLING MACHINERY FOR THE ARCTIC STEAMER ROOSEVELT.

Mr. Robert E. Peary's Arctic steamer *Roosevelt,* which left New York during the month of July to make an attempt to reach the North Pole, was described at some length in our May issue. Through the courtesy of the Portland Company, who constructed her engines and the Scotch boiler, which is to supply half of the steam, we are enabled to give a description of the propelling machinery as fitted to the ship.

The propelling machinery has been designed to develop about 1,000 indicated horsepower under normal conditions, with a boiler pressure of 140 pounds of steam, the engine making 100 revolutions per minute, and a speed of vessel of about 10 knots per hour when she is at her load water-line.

For the purpose for which the vessel is intended it has been deemed advisable to adhere to a moderate number of revolutions of the engine, and to design the engine strong and heavy in all its parts, the better to resist the severe shocks to which it will be subjected in forcing the ship through the ice floes, rather than a lighter and quicker-running engine. The shafting, propeller, and stern bearing have been designed with a consideration to the severe thumping which they will receive when the ship is working



THE ROOSEVELT, READY FOR SEA.
(Photo by J. O. Whittemore.)

its way through the ice, and are exceedingly heavy for the dimensions of the engine.

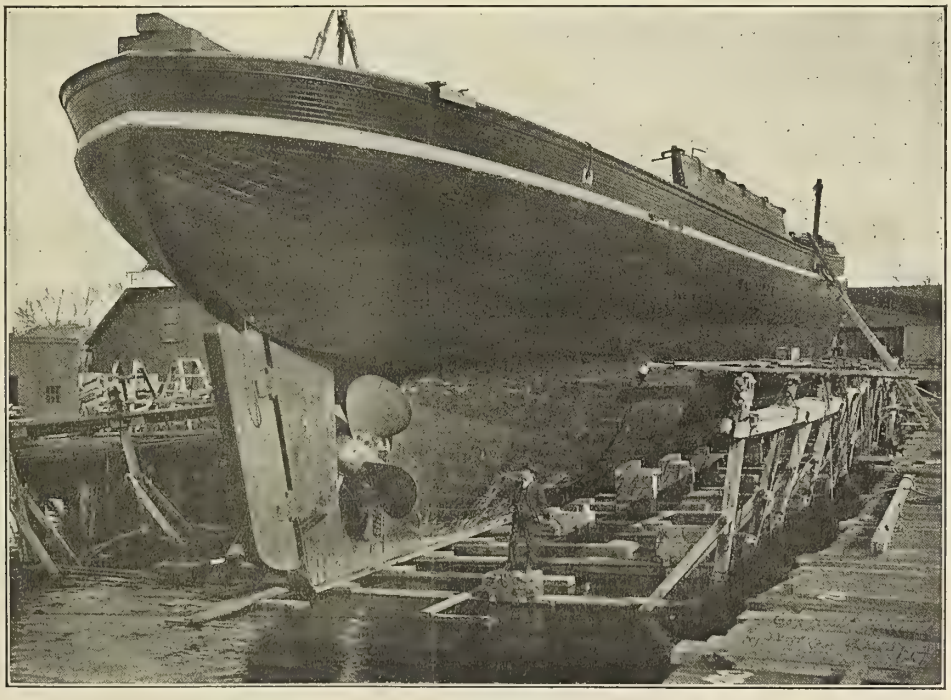
A reserve of power has been provided for in the design of the machinery by providing for an increased boiler pressure, the boiler, engine, and auxiliaries all being designed for 180 pounds steam pressure. This pressure will be resorted to only when the vessel is forcing its way through large ice floes or pushing them before it, and as the revolutions of the main engine will be less, due to decreased speed of ship, the increased boiler pressure is expected to keep the indicated horsepower up to or above the normal.

The following is a general description of the propelling machinery:

THE ENGINE.

The propelling engine is of the compound condensing type, with cylinders 24 and 52 inches in diameter, and a stroke of 30 inches; the ratio between piston areas is thus 4.69 to 1. It is of the open-frame type, with three forged steel columns on the front side and two cast-iron housings on the back side, arranged for single bar guides for the crossheads. All the valves are of the piston type, one for the high-pressure cylinder and two for the low, all these valves being arranged in the space between the cylinders, the center of cylinders being placed far enough apart for this purpose. The valves are operated by Stephenson links of the double bar type. The engine is fitted with steam reversing gear and balanced throttle valve, to be worked from below.

The pistons are of steel castings, single plate and conical in form, and fitted with two packing rings; the piston rods are of forged steel 5 3-4 inches in diameter, the low-pressure piston being

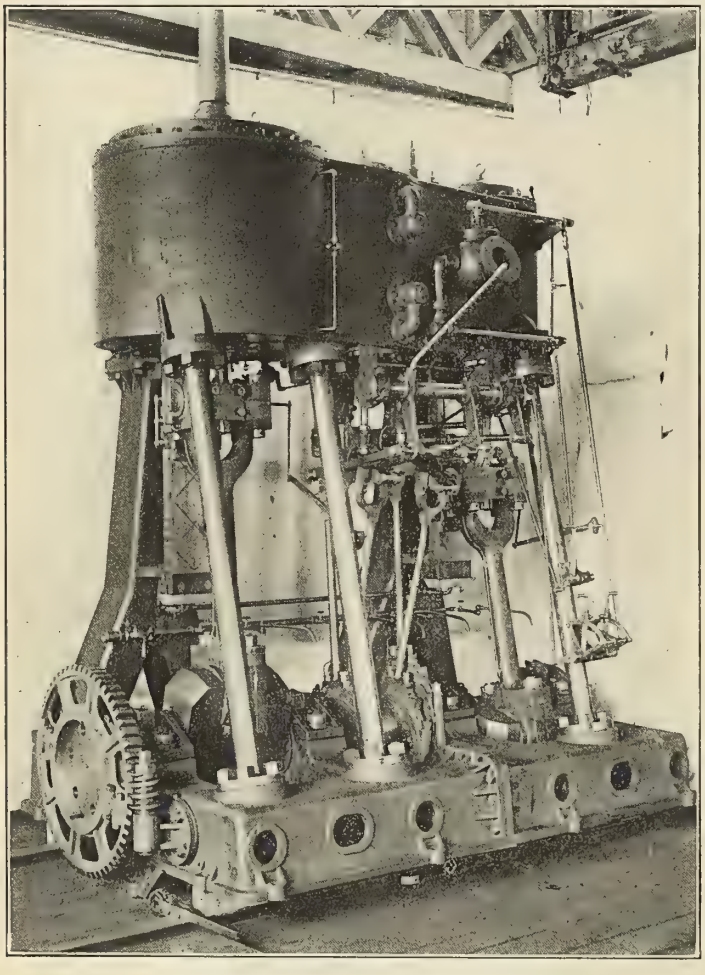


STERN VIEW, SHOWING MASSIVE RUDDER AND PROPELLER.

fitted with tail rod. The crossheads are of forged steel with two gudgeons 5 1-2 inches in diameter and 6 1-2 inches long. The crosshead shoes are steel castings fitted with bronze gibs, 13 inches wide by 20 inches long, on "ahead" surface. The slides are of cast iron cored out for water circulation. The connecting rods are 72 inches long on centers, and are of mild steel forgings; the upper end is forked and fitted with solid bronze boxes, the lower end fitted with cast steel boxes lined with babbitt metal.

The crank shaft is of mild steel forged in one piece, the cranks being at right angles to each other, the low-pressure crank leading when working in ahead gear. The crank pins are 12 inches in diameter and 12 inches long; the four main journals are 12 inches in diameter and 14 inches long.

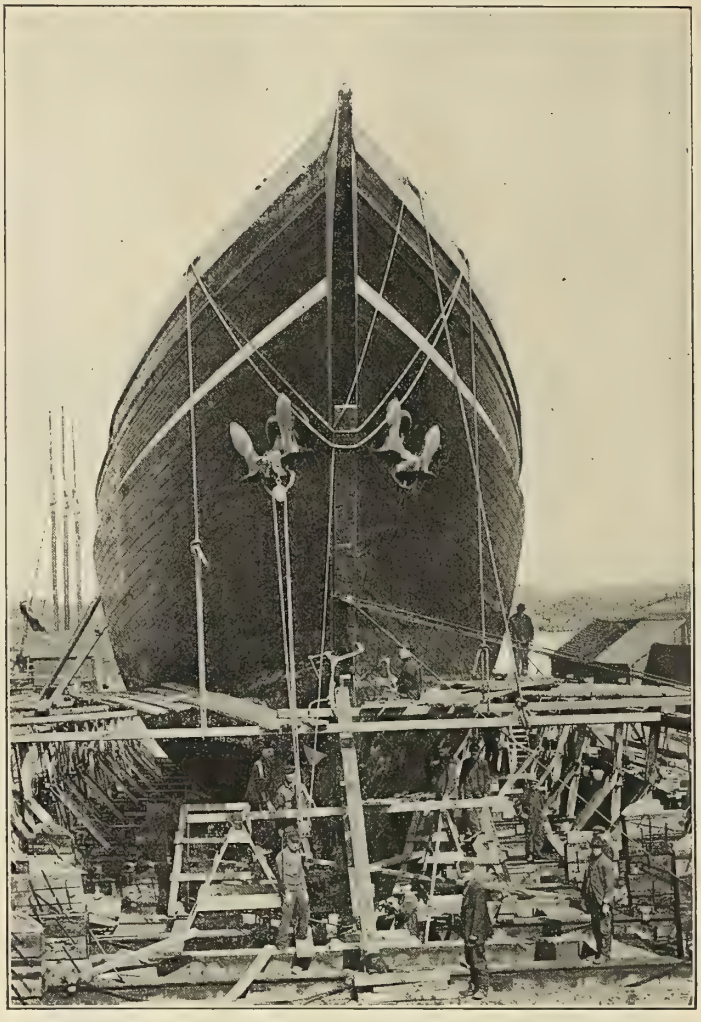
The bed plate is arranged for four main bearings. The bottom half of main bearings is semi-cylindrical in shape and of tough composition lined with babbitt metal; the top half is of steel, cast with the binder and lined with babbitt metal.



THE COMPOUND ENGINE OF THE ROOSEVELT.

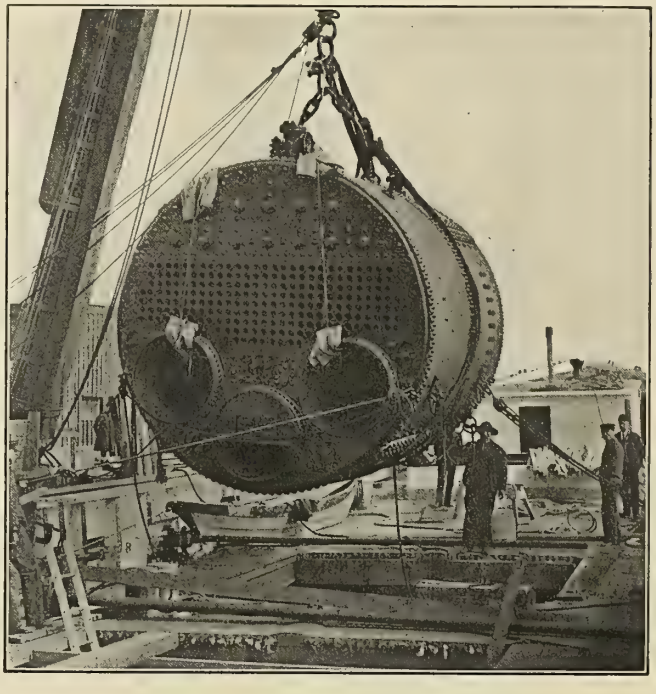
The main valves work in hard cast-iron liners fitted in the steam chests. The valve travel for all valves is 7 inches, and arranged for a cut off in high-pressure cylinder of 65 percent, and in low-pressure of 70 percent of the stroke. The high-pressure piston valve is 12 1-2 inches in diameter, with a port area of 42 square inches. The two low-pressure piston valves are each 14 inches in diameter, with a port area of 124 square inches. The valve stems are of mild steel 2 inches in diameter at the stuffing box; they are guided at each end; the low-pressure stems have balance cylinders fitted at the upper end to counterbalance weight of valves, links, etc.; the lower ends of the low-pressure stems are secured to a cast-steel yoke guided in jaws secured to lower steam-chest bonnets.

The reversing engine has a cylinder 7 inches in diameter by 14 inches stroke, secured to high-pressure cylinder housing. The



A BOW VIEW.

engine is fitted with a worm gear for hand turning; also indicator gear and lubricating arrangement for all the principal bearings.



LOWERING THE SCOTCH BOILER INTO PLACE.

THE SHAFTING AND PROPELLER.

The thrust shaft is of mild steel 11 1-2 inches in diameter with thrust collars 17 inches in diameter, there being seven for ahead motion and three for astern motion. The thrust block consists of two hollow cast iron shells made in halves and divided horizontally, one for ahead and one for astern motion. The shells have recesses cast in for the thrust collars, and the faces are lined with babbitt metal; both shells are mounted on one sole plate, and each is arranged for independent adjustment; the shells are fitted with water circulation, and the thrust collars run in a bath of oil. The propeller shaft is of mild steel 12 1-4 inches in diameter.

The propeller is of the sectional type with right-hand hub and blades of cast steel. It is 10 feet 6 inches in diameter and 12 feet 6 inches pitch, with a pitch ratio of 1.2, nearly. The projected area of all four blades is 56 square feet, this giving 0.648 as the disk ratio, a very large figure, due to the necessity of having great blade areas to overcome the heavy resistances to be met. The propeller is fitted with four blades, but it is intended to use two only when the vessel encounters the ice.

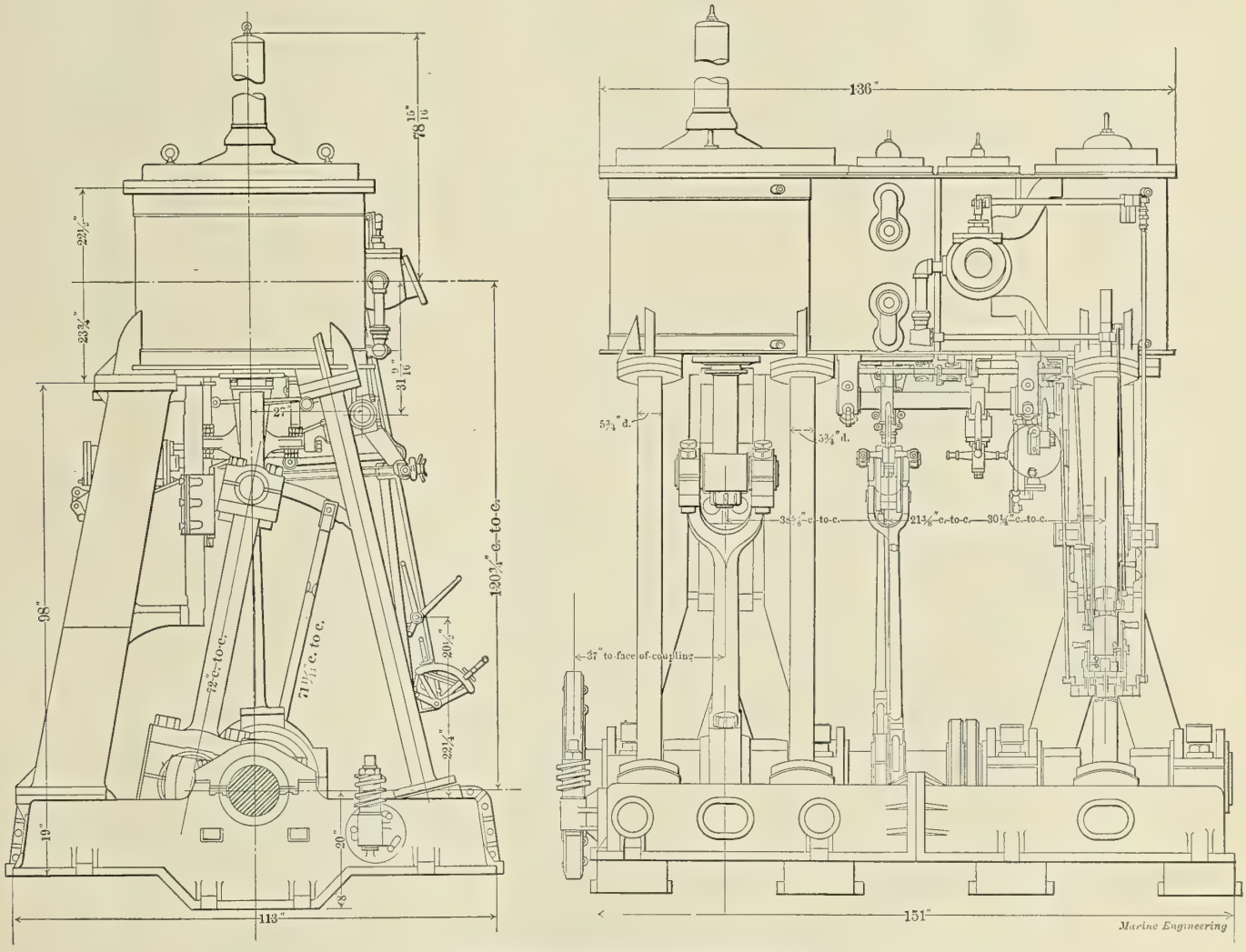
The shaft log is lined with lead 1-4 inch thick and is fitted with inboard stuffing box of cast iron lined with composition. The stern bearing is a steel casting and made very heavy; it is lined with staves of lignum-vitæ, giving a bearing 40 inches long.

THE CONDENSER AND PUMPS.

The surface condenser is circular in form and is independent of the engine framing, being mounted directly over the air pump, the latter forming foundation for one end of the condenser. The shell is of steel plate 7-16 inch thick, with water bonnets of cast iron; the shell is 48 inches in diameter and 8 feet long. There are 1,200 3-4-inch condenser tubes set in composition tube sheets with brass screw glands. The condenser contains 1,800 square feet of cooling surface.

The pumping outfit consists of one 8-inch centrifugal circulating pump, one horizontal simplex vacuum pump, one horizontal duplex main feed pump, and one horizontal duplex auxiliary pump.

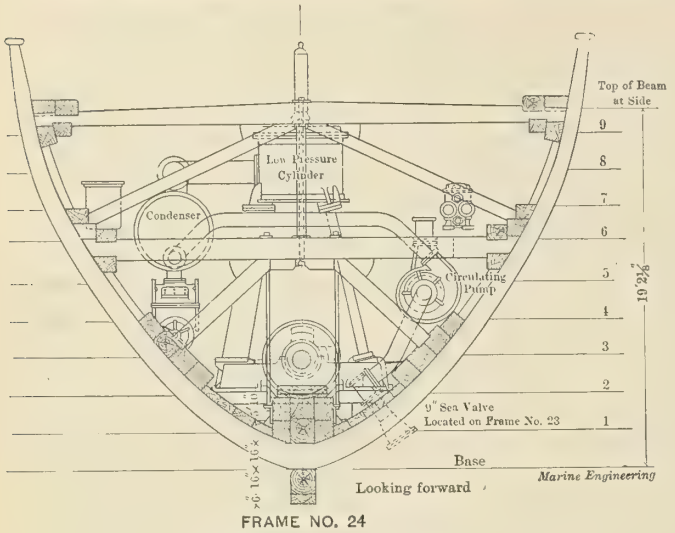
The circulating pump is of the Morris Machine Company's standard pattern, and is directly connected to a 7 by 7-inch engine. The suction of this pump is connected to the Kingston valve with an 8-inch copper pipe; it also has a 5-inch branch to the bilge, fitted with a non-return valve. The discharge to condenser, and from condenser overboard, is through an 8-inch copper pipe.



END AND SIDE ELEVATION OF THE MAIN ENGINE.

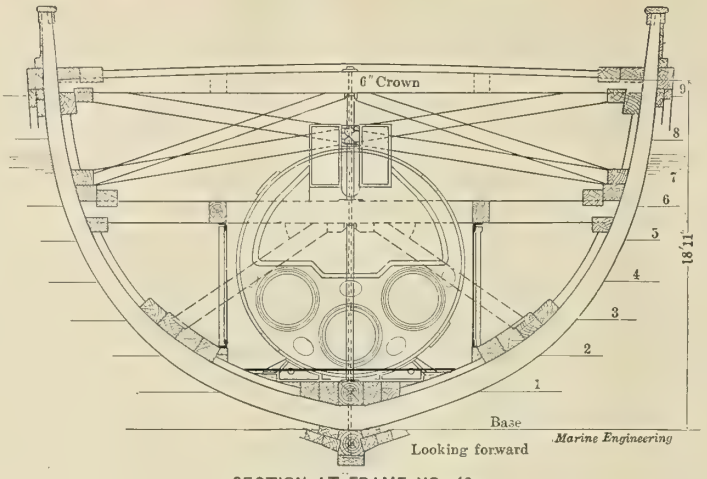
The vacuum pump and two feed pumps are furnished by the Warren Steam Pump Company, of Warren, Mass. The vacuum pump has a steam cylinder 10 inches in diameter, a vacuum cylinder 18 inches in diameter, and a stroke of 18 inches; it is located directly below the condenser, the water end forming a support for one end of the condenser. The air-pump suction is connected to the condenser with a 5-inch copper pipe and discharges to filter tank through a 4-inch copper pipe.

The main feed pump has steam cylinder 8 inches in diameter, with water cylinders 5 inches in diameter and a stroke of 12 inches; the suction of this pump is connected to the filter box and fresh-water tanks only, and discharges to the main feed pipe only. The auxiliary feed pump is of the same dimensions as the main feed pump, the suction being connected to the fresh-water



FRAME NO. 24

SECTION IN WAY OF ENGINE.



SECTION AT FRAME NO. 42
BRACING IN BROKEN LINES ON NO. 41

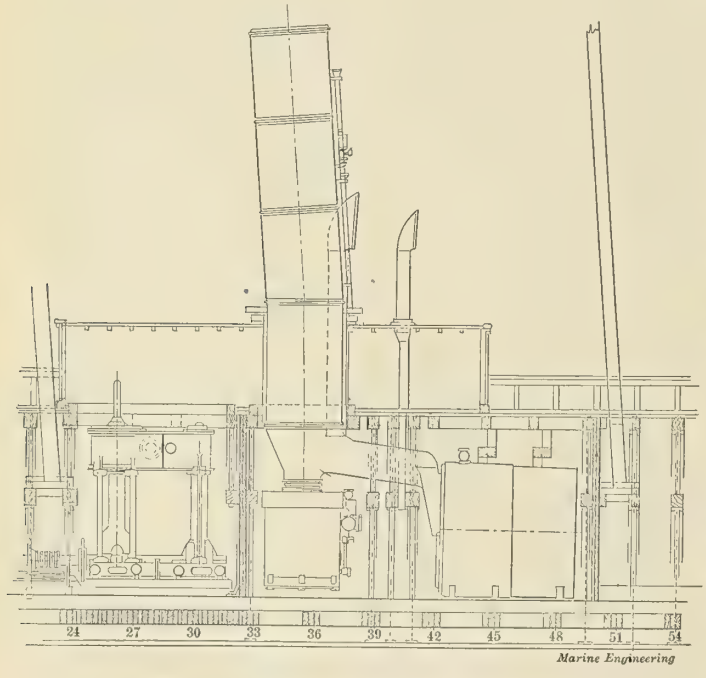
SECTION IN WAY OF SCOTCH BOILER.

tank, filter tank, 6-inch Kingston valve and bilge, with a discharge to the auxiliary feed-pipe line, also to main deck through 2-inch hose-hydrant valves, and a discharge overboard; there is also a 5-inch discharge pipe to the condenser, to be used if the circulator becomes disabled.

THE BOILERS.

Steam will be supplied by one single-ended, three-furnace Scotch boiler and two Almy water-tube boilers. The Scotch boiler is designed for a pressure of 185 pounds, and the safety valves of the water-tube boilers are loaded to this pressure. It is intended that the vessel will steam under 140 pounds working pressure under normal conditions, as explained above.

The Scotch boiler is 12 feet mean diameter and 11 feet 8 inches long outside of heads, and contains three 38-inch Morison suspension furnaces 9 feet long, and 217 3-inch tubes 9 feet long; 153 of these tubes are of ordinary thickness (No. 12) and 28 are of No. 10 gauge, the remainder, 36, are stay tubes tapped into the tube sheets at each end, and fitted with lock nuts. The stay tubes are arranged in the bounding rows, and the extra gauge tubes are arranged in every other row horizontally and vertically.



LONGITUDINAL SECTION THROUGH MACHINERY SPACES.

There are two Class E Almy water-tube boilers, 79 15-32 inches wide, 82 5-16 inches long, and 113 7-8 inches high from bottom of ash pan to top of hood.

The heating surface and grate area are as follows:

	Heating surface, sq. ft.	Grate area, sq. ft.	Ratio.
One Scotch boiler,	1,772	54	32.9
Two water-tube boilers,	2,572	60	42.9
Total,	4,344	114	38.1

The boilers are arranged in a watertight compartment, the Scotch boiler forward and the two water-tube boilers aft, the latter being arranged side by side and connecting into one smoke box. There is one smoke stack for all three boilers. It is made oval in plan, 7 feet in a fore-and-aft direction, and 3 feet athwartship, and is located directly over the water-tube boiler, with a flue connecting with uptake on Scotch boilers.

The main steam pipes and branches are all of copper, and the auxiliary steam pipe is of copper, but the branches are of extra thick wrought iron pipe with steel fittings. The boilers and steam pipes are covered with non-conducting material applied by the C. W. Trainer Manufacturing Company, Boston, Mass.

GENERAL.

The boilers, engine, steam piping, and all the auxiliaries are designed strong enough in all parts for the maximum steam pressure of 180 pounds, and they comply in all respects with the rules and regulations of the Supervising Inspector of steam vessels of the United States. The coal bunkers extend the length of the boiler space in the vessel; each side of the boiler and fire room they have a capacity of about 120 tons.

The fresh-water tanks are located in the after part of the vessel, being built to fit in between the "'tween" deck beams, and they fit the shape of the vessel where located. They have a capacity of about 2,400 gallons. In connection with the fresh-water tanks there will be a large open tank on deck, fitted with steam pipes for the purpose of melting fresh water ice.

The minimum of space has been allotted to the machinery, as it is necessary to use all the space obtainable for coal and other supplies. Every cubic foot in the machinery space has been utilized with machinery, lockers, etc., with just enough clearance to get at the different parts. The weight of the entire machinery, ready for sea, excluding coal and water in tank, is about 137 tons.

For this description, and the illustrations accompanying same, we are indebted to the Portland Company, of Portland, Me., the builders of the engines and of the Scotch boiler.

THE FIRE-BOAT GEORGE H. WILLIAMS, OF PORTLAND, OREGON.

This new fire-boat has been in service nearly a year, and has proved herself a complete success. We present herewith a general description and a few illustrations which may be of interest to our readers.

It was the original intention of the Fire Department and the designer to have the hull built of steel, but bids received exceeded the appropriation of $62,000, and a wooden boat had to be built. In order to reach certain parts of the harbor, the draft had to be limited to less than six feet, and for this reason the model had to be full and twin screws had to be chosen. The hull is built very staunchly of Oregon oak and yellow fir. The outside is double-planked diagonally next to the frames and fore-and-aft outside.

As no heavy weather has to be met the boat is very low above the water and has not much sheer. The hull is 115 feet over all, 102 feet between perpendiculars, 25 feet molded breadth, and 8 1-2 feet molded depth. The displacement is 240 tons ready for duty. The hull is divided into four compartments by bulkheads. The first compartment contains chain lockers, the second hose reel, and stores, the next the two boilers and fire room, the fourth pumps, propelling machinery and workshop.

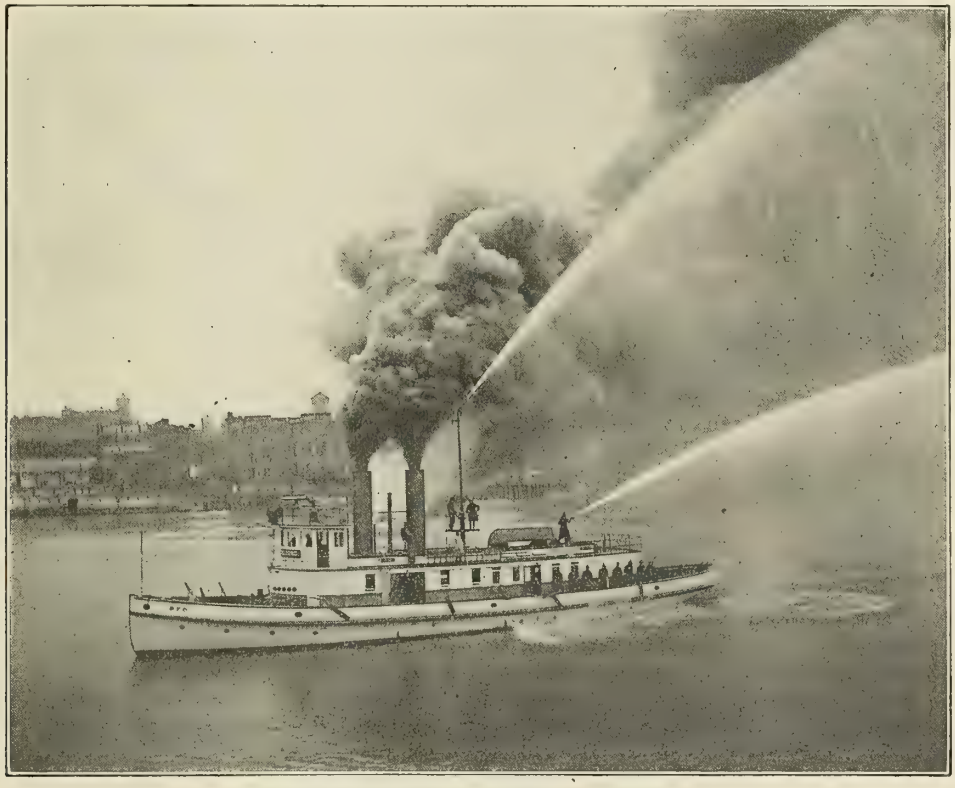
The deck-house has a circular front and extends aft over 70 feet and is 14 feet wide. It is subdivided by bulkheads as shown in plan, containing in first compartment valves and nozzles with ten 3 1-2-inch outlets around the circular front; in next, the boilers and pipings; next, the engine room; aft of this, both toilet and lamp room; and then two hose reels. The pilot-house is placed on top of the deck-house and carries on top a 6-inch Monitor nozzle and an 18-inch searchlight. A continuous trunk skylight runs from the pilot-house aft. The upper decks are sheathed with heavy zinc for protection against sparks.

The vessel is provided with four pairs of strong oak mooring bitts, a pair of tow posts, iron chocks, a capstan windlass, metal lifeboat with skids, etc.

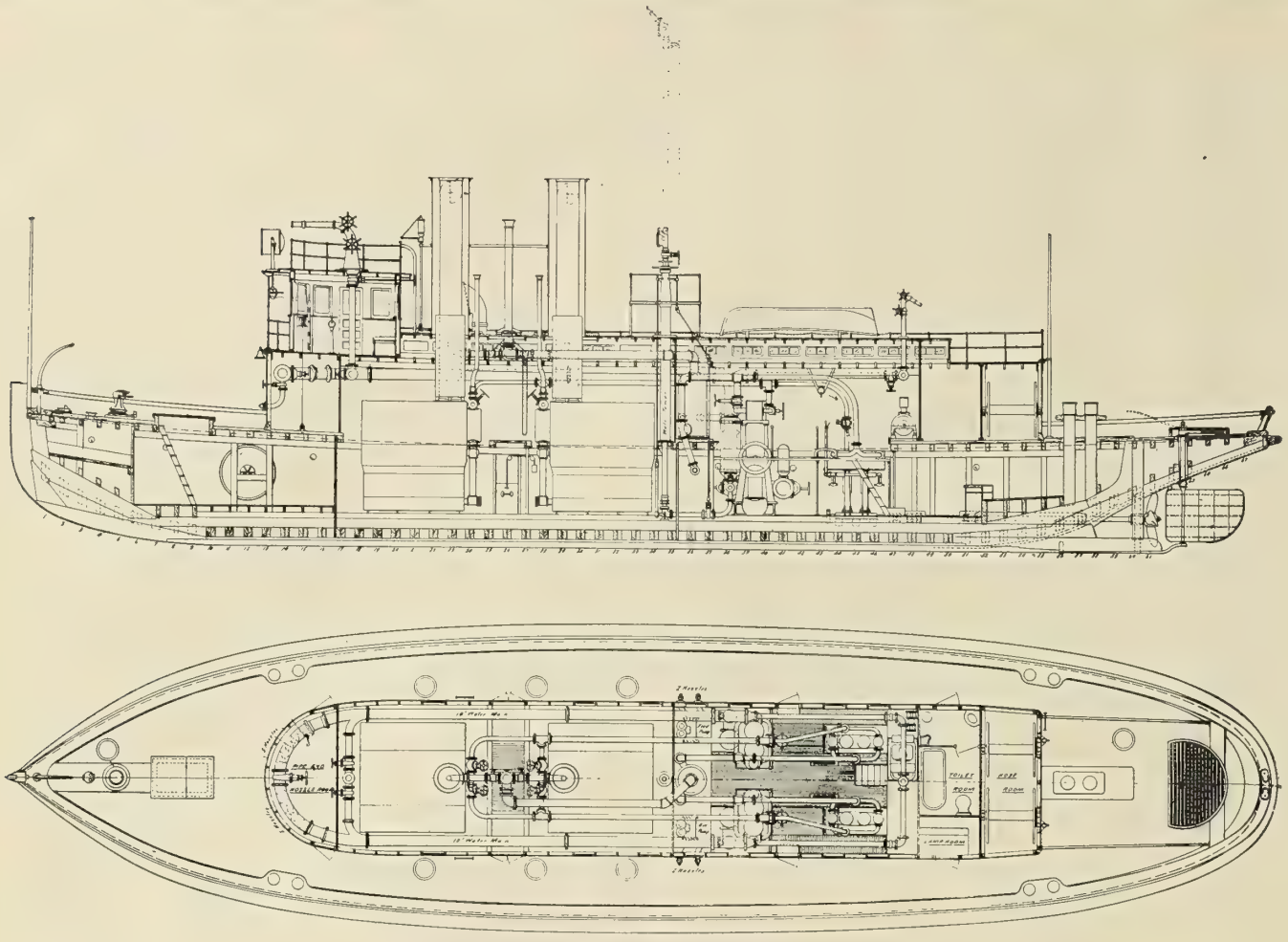
To insure good steering the rudder is made exceptionally large, and the deadwood between skeg and hull is left open. The boat will double on her track at full speed in thirty seconds, and within a radius of fifty feet.

The propelling machinery consists of two pairs of high-pressure engines, having cylinders with 10-inch bore and 14-inch stroke, turning with 160 pounds at 250 revolutions per minute, and operating propellers with a diameter of five feet. The indicated horsepower developed on trial was 434, driving the vessel 12 miles an hour. As the water of the Willamette is fresh, condensing apparatus was not required.

There are installed two of the latest American Fire Engine Company's fire pumps, each having two steam cylinders 17 inches in diameter and water cylinders 10 inches in diameter, with a common stroke of 11 inches. The pumps are of the direct-connected, fly-wheel, vertical type, and at 240 revolutions will discharge 6,748 gallons of water per minute. In order to maintain this high speed safely and without undue vibrations, the pumps are seated on a pair of 12-inch I-beams resting on four continuous keelsons, thus distributing the vibrations over the whole bottom. A 16-inch suction main connects with two 24-inch sea-openings, as shown on cross section. By closing sea-valves and opening valve to bilge the vessel may be kept clear in case of accident. Opening is also provided in suction pipe to utilize pumps for wrecking purposes. Each pump has a 12-inch discharge dividing under cabin deck into one 10-inch and one 5-inch branch. The 10-inch branches from each pump run forward and are connected together by a circular manifold from which ten 3 1-2-inch nozzle branches are taken, couplings and valve-wheels projecting through front of house. The couplings are made especially to take the 3 1-2-inch, 3-inch, and 2 1-2-inch hose connections. From the vertical 12-inch discharge pipe branches are taken to two 3 1-2-inch hose connections, each side of house, so that in all fourteen of these connections are provided. The discharge pipes are made of semi-steel with male and female flanges, and the system was tested under 500 pounds cold-water pressure. To relieve sudden



THE FIREBOAT GEORGE H. WILLIAMS AT WORK.



INBOARD PROFILE AND DECK PLAN OF GEORGE H. WILLIAMS.

shocks and expansions, copper sections were used between circular manifold and main pipes, which are branched again aft of nozzle room to supply the 6-inch turret nozzle on top of pilot house. Valves are so arranged that either pump can supply the whole system or only half. The 5-inch branches leading aft from 12-inch vertical discharge pipe supply water to a 2 1-2-inch deck turret.

Steam is generated by two Taylor water-tube boilers of latest design. They have a total heating surface of 4,500 square feet and a grate surface of 96 square feet. They have 36-inch steam drums tested for a working pressure of 250 pounds. Stop valves and steam pipes are in duplicate so that one or both boilers may be used on either port or starboard pump or engine.

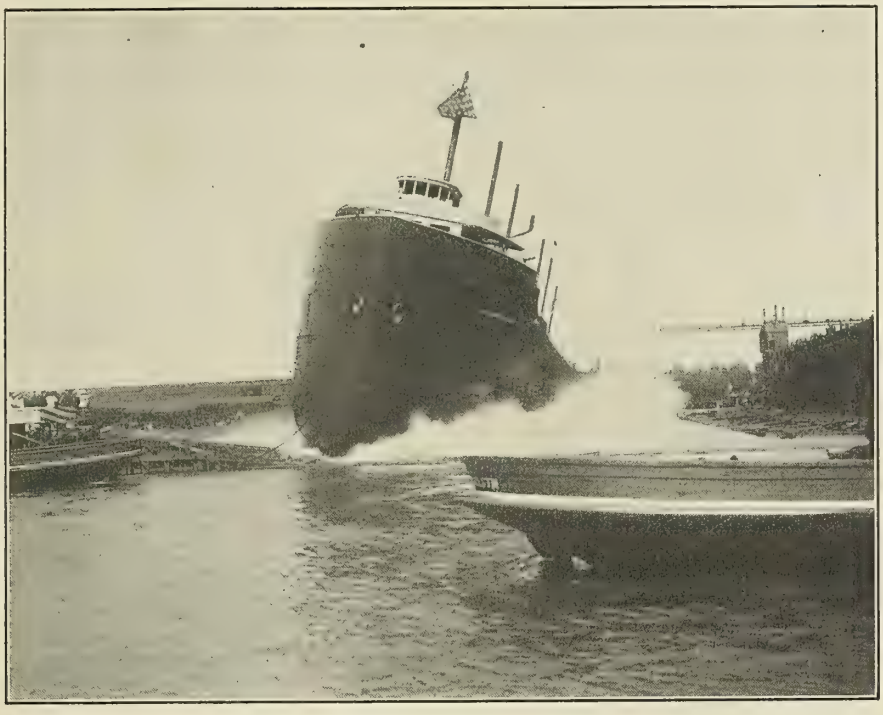
The boilers have independent smokestacks, which not only improves their efficiency but also insures a cooler fire-room. The exhaust from machinery, after passing through heater located in engine-room, is used for draft in stack, or may, by a simple system of butterfly valves, be exhausted directly into the atmosphere.

The boilers have exceeded in their performance all expectations. On trial, pumps and propelling engines were run at full speed, and dampers on boilers had to be kept closed frequently to stop the blowing off. While boat is on duty steam is kept in both boilers at 150 pounds, and records kept show that 1,500 pounds of ordinary Pacific Coast coal is used every 24 hours. The great advantage of these boilers over the Scotch type lies in the small space occupied, their capacity, economy, light weight, quick steaming and high pressure. On test 150 pounds of steam was raised in a cold boiler in 6 1-2 minutes. The steam after leaving boiler is reduced to 150 pounds for the pumps.

The auxiliary machinery consists of two Admiralty type Worthington pumps of 80 gallons per minute capacity, located against the forward bulkhead in engine room, within easy reach of the engineer. The main feed-pump discharges through a copper-coil heater located between the two pumps. This heater has an exhaust connection to a siphon condenser discharging overboard to relieve the pressure in heater due to the choking of exhaust in smokestacks.

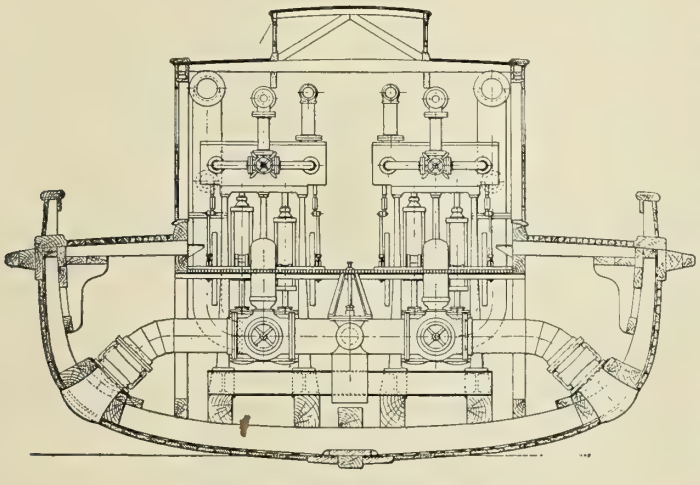
The boat is equipped with a 7-Kw. direct-connected General Electric generating set, and lighted with electricity throughout. The wiring in boiler-room is in metallic conduits. The latest improved steam-tight fixtures, switches, and cut-out boxes have been used. The electric wiring is connected with the shore, releasing automatically when the vessel leaves the dock.

A novel feature of the boat is the water-tower, invented by the designer. This tower represents the first one ever installed on a fire-boat and has proven itself a great success. It is located forward of the bulkhead between engine and boiler-room and occupies very little space. In principle it consists of a 4-inch brass standpipe supported at keelson in an elbow connected with the discharge ends of each pump, the inlet to pipe being regulated by a gate valve having its stem extended to a platform on top of deck-house. Over the brass standpipe telescopes a 5-inch extra heavy turned steel pipe, having at its bottom end a stuffing box, and carrying on top a gate valve and flexible nozzle, which can be raised or lowered by a rope purchase. The valve is fitted with a chain wheel and chain and can be operated when tower is at any height. The 5-inch pipe is guided by the standpipe on the inside and on the outside by the stand above platform, and supported by a 10-inch pipe on the main deck and braced to the house. A split-sleeve is supported in this stand and when the pipe is raised to the desired elevation this sleeve is tightly clamped to pipe. The sleeve is surrounded by ball bearings so designed that vertical and lateral strains cause no undue friction, and at bottom of stand another ball bearing takes care of the lateral and vertical pressure when



SIDE LAUNCH OF WILLIAM E. COREY.

the pipe is at its extreme height. To the sleeve is keyed a large brass hand-wheel by which the tower or extended pipe may be swung around its axis. A relief valve is connected to the bottom elbow and its stem is also extended to the platform, so that by opening same the tower can be lowered after the pressure has been shut off by a simple opening of this relief valve. On test the tower threw a 2 1-4-inch stream a distance of 450 feet from



SECTION IN WAY OF ENGINE ROOM.

an elevation of 45 feet above the water-line. It is operated by one man.

The equipment of the boat includes three hose reels, working in ball bearings, each capable of carrying one thousand feet of 3 1-2-inch hose with couplings. One reel, as above mentioned, is below deck forward, and the other two in after end of deck-house. The hatch and door openings are fitted with rollers to guard against the hose dragging and cutting. For working hose on deck short lengths are provided and special crutches set in sockets in rail are furnished.

The fire-boat was designed by Fred. A. Ballin, of Portland, and built by the Willamette Iron and Steel Company of Portland, who sublet the hull to the Portland Shipbuilding Company.

The Launch of the William E. Corey.

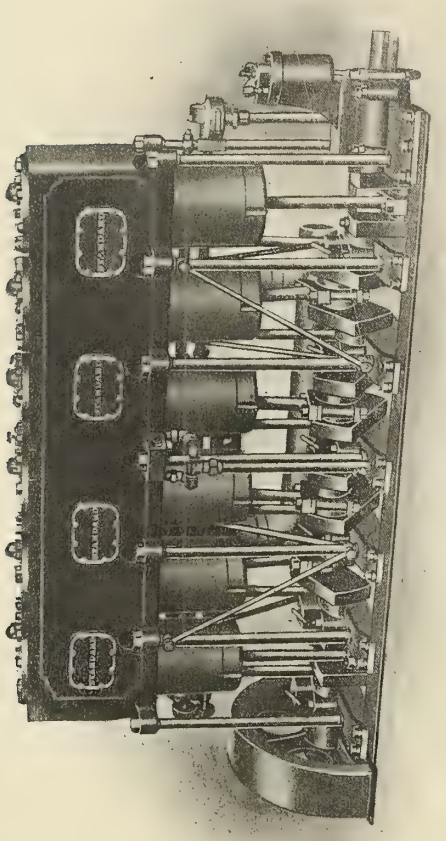
This new sister ship of the *Elbert H. Gary*, the *George W. Perkins*, and the *Henry C. Frick*, was launched June 24 from the South Chicago yard of the American Shipbuilding Company. We give an illustration of this launch, which it will be noted was from the side.

The four ships above mentioned are the largest vessels on the Lakes, having a length over all of 569 feet, a keel length of 549 feet, a beam of 56 feet, and a depth of 31 feet. The tonnage is 4,988 net and 6,331 gross. The estimated cargo-carrying capacity is 11,000 tons. With engines of 1,800 horsepower it is expected that a speed of about twelve miles will be maintained. In order to insure great carrying capacity, the hopper principle adopted in the *Augustus B. Wolvin* last year has been developed to an even greater extent than was the case on the prototype, and it is expected that these four ships will prove to be in many ways the most economical to operate on the Great Lakes.

The Launch Gregory.

Ninety feet long, with a 12-foot beam and 4-foot draft, this launch is propelled by two 300-horsepower, six-cylinder, reversible, "Standard" gasoline engines, and is lighted by a "Standard" direct-connected electric-light plant of 4 horsepower. The boat contains forward three tanks, with a capacity of 1,500 gallons; she also contains four tanks aft, with a capacity of 2,500 gallons, making a total of 4,000 gallons, which equals in weight, approximately, 13 tons. With 6 tons of fuel aboard, the total weight of the boat was designed for 30 tons displacement. The accompanying chart illustrates the fuel consumption trials, which were made to determine the feasibility of crossing the ocean on its own tank capacity.

It will be noticed that when driving under one engine with the other propeller uncoupled, so as to allow it to rotate freely, the boat can sail 5,050 miles, when running at the rate of 7.77 miles per hour. When running at the rate of 10.63 miles per hour she can sail 4,600 miles. When running at the rate of 13.16 miles per hour she can sail for 3,360 miles. It will be noticed in comparing these figures with the work of the government torpedo boats that sailed to Manila, that the fuel con-



SIX-CYLINDER ENGINE OF THE GREGORY.

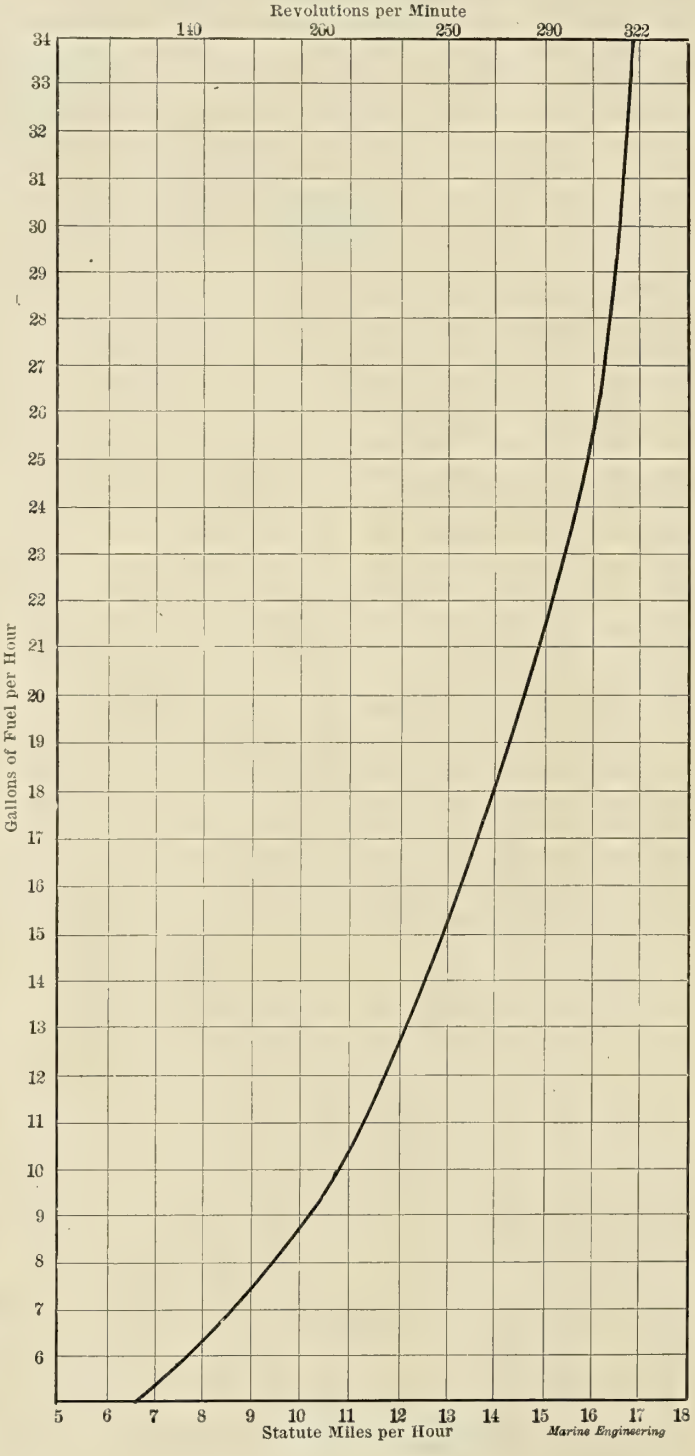
sumption is far more economical than with coal. The smallest government boat carried some 190 tons of coal when leaving San Juan, and steaming at the rate of 10 1-2 miles per hour they found it necessary, or considered it so, to coal at sea before arriving at the Azores, a distance of only 1,700 miles. To compare these figures with the *Gregory*, a boat much smaller in every way, which carries only 13 tons of fuel, but is able to operate more than 2 1-2 times as far without resorting to deck loads and auxiliary fuel-storage compartments, certainly indicates the great advantage that the internal combustion engine operating on liquid fuel has over steam on long cruises.

The maximum speed of the boat has not as yet been exactly determined; a speed of 23 miles having been made while the boat was loaded beyond her regular trim. Under these conditions the fuel consumption is some sixty odd gallons per hour. This would drive the boat at full speed nearly 1,400 miles, which is again considerably more than high-speed boats of the torpedo type could ever accomplish.

TABLE OF PERFORMANCE.*

R.P.M.	Speed, Knots.	Speed, Miles.	Fuel per hour, gallons.	Radius of action, Days.	Radius of action, Miles.
145	6.75	7.77	6.12	27.3	5,050
202	9.23	10.63	9.6	17.4	4,605
252	11.43	13.16	15.65	10.7	3,360
322	14.50	16.70	32.7	5.1	2,040

*Port engine running. Starboard propeller uncoupled.



FUEL CONSUMPTION CHART OF GREGORY.

THE GREGORY.

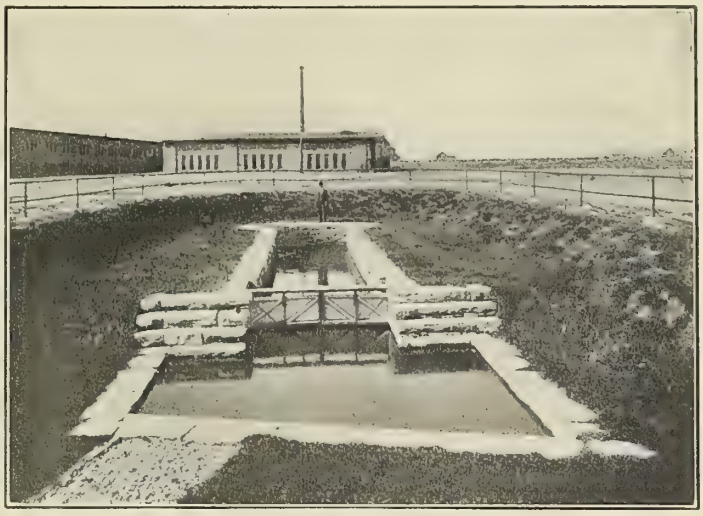
The *Gregory* had a very difficult passage across the Atlantic, having left New York originally January 5 for Bermuda and being driven back by a high storm. She left again February 8 and reached Bermuda February 16. On March 1 the voyage was resumed, the boat heading for the Azores. Another storm being encountered, however, she again had to put back to port with one cylinder broken. She finally left Bermuda March 19, and reached the Azores April 4, after having passed through another heavy storm. The provision of gasoline was now exhausted and it was necessary to await a new supply from Lisbon, which required a stay of more than a month. On May 10 the Azores were left and Algiers reached the 17th. Since that time the motor boat has passed through the Dardanelles and arrived at Sebastopol, where she was turned over to the Russian government for use as a torpedo despatch boat.

THE SEMI-CENTENNIAL OF THE SOO CANAL.

The first lock ever constructed on the American continent was built by the Hudson Bay Company at the falls of the Sault Ste. Marie in the year 1797-98. It had a length of 38 feet, a width of 8 feet 9 inches, a depth of 9 feet, and a draft of 2 feet 6 inches. It was destroyed by an American force in 1814, but has been repaired, and may be seen at the Soo, in the yards of the Lake Superior Power Company. It will be noted from the figures given that this lock with its abutments complete could have been placed athwartship in one of the large steamers now running through the present locks of the Sault Ste. Marie canal, and the space it occupied would scarcely be missed.

The present canal, however, was first built and put in operation early in the second half of the nineteenth century, having been opened June 18, 1855. It was built under the auspices of the state of Michigan, and cost in round numbers about $1,000,000, while the cost for maintenance increased from $4,400 in the first year to about $9,000 in 1880. Tolls were charged of four cents per ton up to 1877, and then three cents per ton until 1881; but when on June 9, 1881, the entire canal property was transferred to the United States government, tolls were abolished and the canal and locks were made free for vessels of all classes.

In the meanwhile a new lock had been under construction, and this, the Weitzel lock, was opened September 1, 1881. It is 515 feet long and 80 feet wide, with a width at the gates of 60 feet,



THE FIRST LOCK IN AMERICA.

(Photo by A. E. Young.)

and cost approximately $2,180,000. The present largest lock is known as the Poe lock, and was opened August 3, 1896. This is on the site of the original lock of 1855. Built at a cost of about $3,000,000, this lock has a length of 800 feet and a width of 100.

The original locks of 1855 were the largest in existence. They were two in number, and placed in tandem, each being 350 feet long, 70 feet wide, 11 1-2 feet depth of water, and a lift of about 9 feet. The depth of water in the Weitzel lock is 17 feet, with 16 feet over the sill; while that in the Poe lock is 21 feet.

The original canal had a length of slightly more than one mile, a width at the bottom of 64 feet, and at the surface of the water 100 feet, and was 13 feet deep. While the Weitzel lock was under construction the mean width of the canal was increased to 160 feet and the depth to 16 feet. Since 1892 the American canal has been deepened to 25 feet and somewhat extended in length, so that it is now 1.6 miles from end to end. The width varies from 108 feet at the canal gate to 270 feet at the basin above the locks, 500 feet at the upper entrance, and 1,000 feet at the lower entrance.

THE WEITZEL (AT LEFT) AND POE (AT RIGHT) LOCKS, LOOKING TOWARD LAKE SUPERIOR.

(Copyright, 1905, Detroit Photographic Company.)

STEAMER SONOMA LEAVING WEITZEL LOCK.

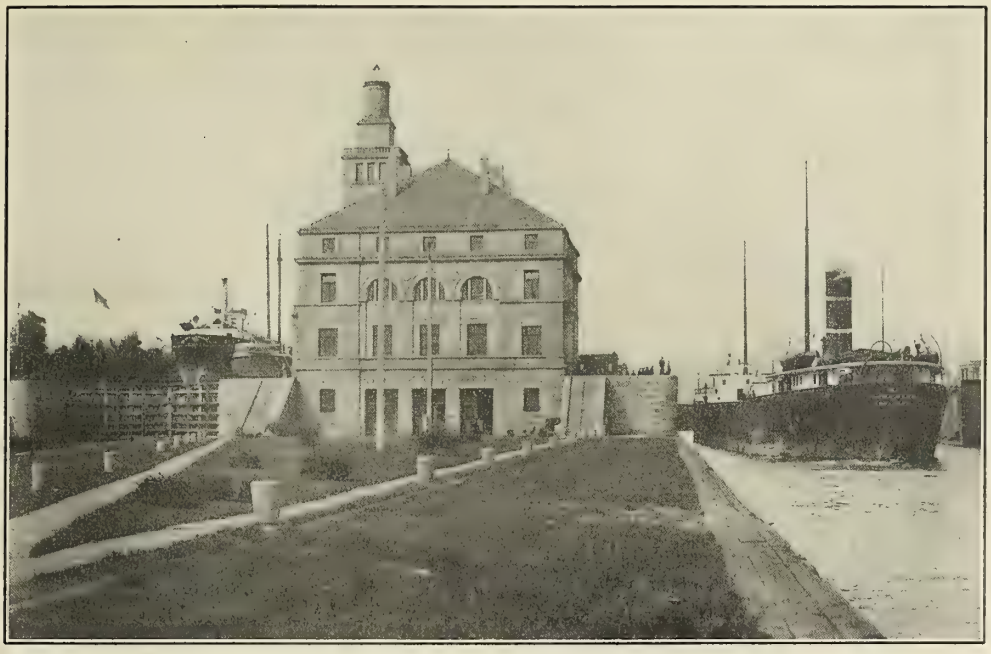
(Copyright, 1905, Detroit Photographic Company.)

The Poe lock is so admirably fitted for its duty that it can be filled or emptied in about seven minutes, and the gates opened or closed in two minutes. It is on record that a single boat 350 feet in length has made a passage through the lock in eleven minutes. The average time last season, however, was about twenty-nine minutes, due largely to the slow movement of boats in entering and leaving. The average time through the Canadian lock, which is 1,000 feet long, 80 feet wide, and with 22 feet of water on the sills, was 16 minutes.

As an indication of the immense traffic through these canals we will quote figures for the season of 1904, which was, by the way, a considerably smaller one than the preceding year. The number of steamers passing through the canal was 12,188; sailing vessels 2,994, and unrigged vessels 938; making a total of 16,120, or 72

CAPACITY OF POE LOCK SHOWN BY FOUR STEAMERS IN IT AT ONCE.

(Photo by A. E. Young.)



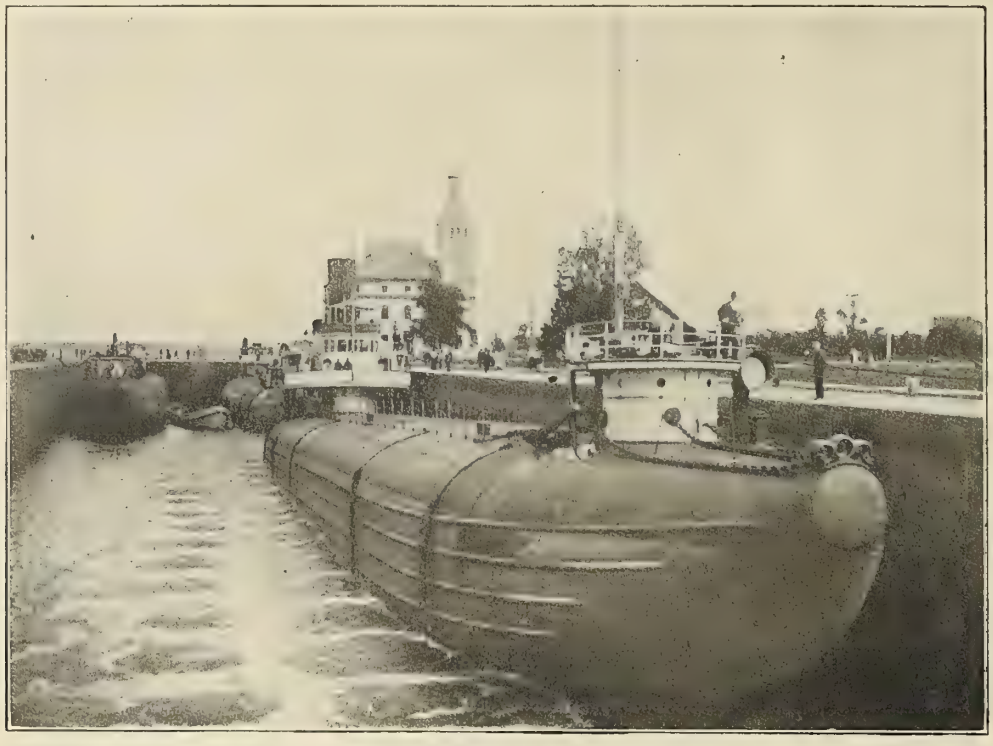
THE ADMINISTRATION BUILDING AND LOCKS.
(Copyright, 1905, Detroit Photographic Company.)

ships per day during the season of 223 days. The number of lockages was 10,315, or 46 per day.

The net tonnage register of the ships passing through was 24,364,138, or 109,000 per day and 1,516 per ship. The quantity of freight carried through in that time was 31,546,106 tons, or 141,000 per day and 1,961 per ship. Of this freight, iron ore accounted for 19,635,797 tons, or 88,000 per day, and coal for 6,454,869 tons, or 29,000 per day. The largest traffic for a single day was September 6, when 99 vessels carrying 287,399 tons of freight, or an average of 2,913 tons each, passed through the canal. The total value of the freight carried was estimated by the shippers at $340,000,000, while the amount paid for its transportation was $21,552,894. As the average distance carried was 843 miles, the cost of carriage figures out at less than one mill per ton per mile.

As an indication of the great intensity of this traffic it may be stated that although the number of ships passing through the canals were given as 16,120, the actual number of different ships was only 886, which shows that each ship must have passed through on the average eighteen times. As another indication of the immensity of the operations, it may be mentioned that the registered tonnage passing through the canal during the season was three-quarters as great as the entire registered tonnage of all ships in all the mercantile navies of the world, and is upward

THE NORTHWEST IN THE POE LOCK.
(Photo by A. E. Young.)



WHALEBACKS IN THE POE LOCK.
(Photo by A. E. Young.)

of four times the entire registered tonnage of all the ships in the merchant marine of the United States, and about thirty times the total tonnage of American ships engaged in the foreign trade.

It is proposed to hold a celebration to commemorate the fiftieth anniversary of the opening of this canal, the celebration taking place at Sault Ste. Marie, Mich., on August 2 and 3, 1905. The plan for the first day includes sports of various kinds on the water and on shore, with a display of fireworks in the evening. On the second day there will be given addresses by representatives of the United States, of the Dominion of Canada, and of some of the state governments, ending with a reception by the governor of Michigan. The general charge of the celebration, including the erection of a permanent memorial at Sault Ste. Marie and a preparation of the history of the canal, is entrusted to the Lake Superior Canal Semi-Centennial Commission of 1905, the members of which as appointed by the governor of Michigan are Peter White of Marquette, president; Horace M. Oren of Sault Ste. Marie; and Charles Moore of Detroit, secretary and treasurer.

A BLOCKADE, DUE TO A FEW HOURS' STOPPAGE AT THE LOCKS.
(Photo by A. E. Young.)

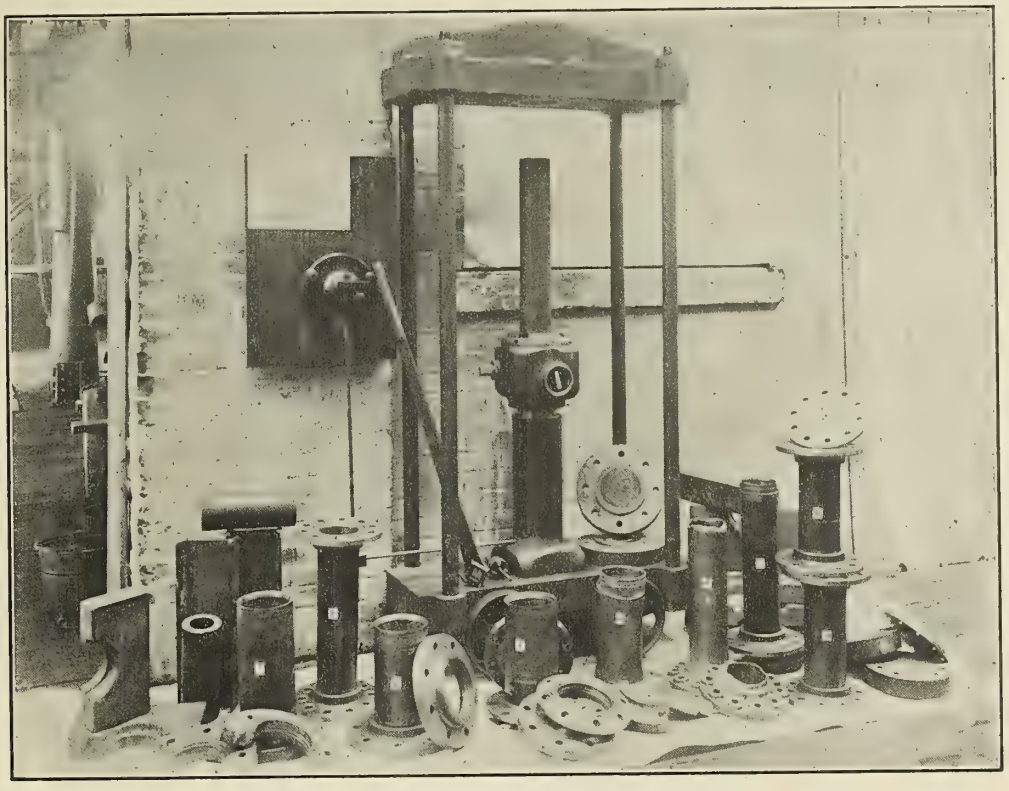


FIG. 1. APPARATUS AND TESTED PIPES AND FLANGES.

TESTS OF COLD-ROLLED FLANGED-PIPE CONNECTIONS.

BY LUTHER D. LOVEKIN.

In order to demonstrate the practicability of copper pipes rolled into steel flanges by machinery, and also to demonstrate the ability of machinery to place flanges on steel pipe, such as is used by our Navy Department at present, as well as other miscellaneous forms of joints, a series of tests was conducted, the results of which are herewith appended. These tests have clearly shown the great advantage of cold-rolled joints for all copper pipe, as compared with the old practice of brazing the pipe to the flange (which is both expensive and dangerous); and the rolling of steel pipes into flanges has met with such general favor among those who witnessed the tests that it is believed screwed pipe joints on sizes of over 6 inches diameter will be eliminated at an early date. In all cases of cold-rolled joints for all steam pressures, whether superheated or otherwise, it appears that the question of expansion and contraction can be eliminated in considering the adaptability of these joints.

The tests were made to ascertain the strength and tightness of pipes and joints made by expanding the pipes into flanges by flowing or extruding the metal cold into grooves of a special form, and also to form a comparison with brazing metal flanges, which were brazed to the pipe. The test pieces were made to fulfill actual working conditions as nearly as possible; the number and size of bolts, the size of flanges, etc., being the same as used in regular practice in most cases.

The tests were made at the works of Dienelt and Eisenhart, Inc., Philadelphia, by Mr. Fred. Kauffman, who arranged the apparatus as shown in the accompanying cuts. Owing to the number of tests it was impossible to complete them all on Tuesday, February 14, and those present agreed to accept the reports of Captain Bergdorff, U.S.N., and Naval Constructor J. W. Powell, for the balance of the tests, and Thursday, February 16, was fixed to complete them.

The apparatus used in making the tests is fully shown in Fig. 1. It consisted of a hydraulic jack of 40 tons capacity (shown in Figure 2) set between two heavy cast-iron plates, held about five feet apart by four bolts 1 3-8 inches in diameter; the cylinder of the jack was drilled and tapped at the bottom for an 1-8-inch standard gas-pipe thread, and an 1-8-inch standard iron pipe-size copper pipe connected the jack with the pipe to be tested by hydraulic pressure; in this pipe line was connected a heavy tee, from the side leg of which an 1-8-inch pipe connected to a Shaw differential plunger mercury test gage, for accurately indicating the pressure per square inch created by the jack pump.

For the pulling tests a cast-iron equalizing plate in halves 2 inches thick rested on two short pieces of 6-inch I-beams, these in turn resting on two pieces of 3-inch square steel, with two vertical 3-inch diameter struts resting on the under face of the top plate of the press as shown. The equalizing plate mentioned is a flat plate, in halves, cut out to clear the outside diameter of the test pipes, and is intended to equalize or distribute the pulling load over the entire flat surface of the flange on the test pipe, and thereby prevent breaking the same, due to excessive bending, had the flange been supported on two sides only.

In making the hydraulic tests the above described frame used for the pulling tests was removed and in its place a 4-inch diameter bar of sufficient length to reach from the top of the jack to the under side of the top plate of press was used; the test piece was filled with water and connected to the free end of the 1-8-inch pipe. Upon working the jack pump the 4-inch bar prevented the ram from raising in the cylinder of the jack, thereby creating pressure in the test piece; the pressure was accurately shown by the gage before mentioned.

In making the pulling tests, the piece of pipe used to connect the test piece to the tee was removed and the tee plugged; thus leaving the 1-8-inch pipe connection from the jack to the gage only; the 4-inch bar from the top of the jack to the under side of the top press plate was also removed, and in its place the above described frame was set, with the test piece in the center. One blank flange was bolted on the top end of the test pipe, and between this and the head of the jack a round bar, a few inches longer and somewhat smaller in diameter than the inside of the test piece, was placed. On working the jack pump the ram raised and pushed the center bar against the blank flange on the top of the test pipe, raising this and also bringing the regular flange on the lower end

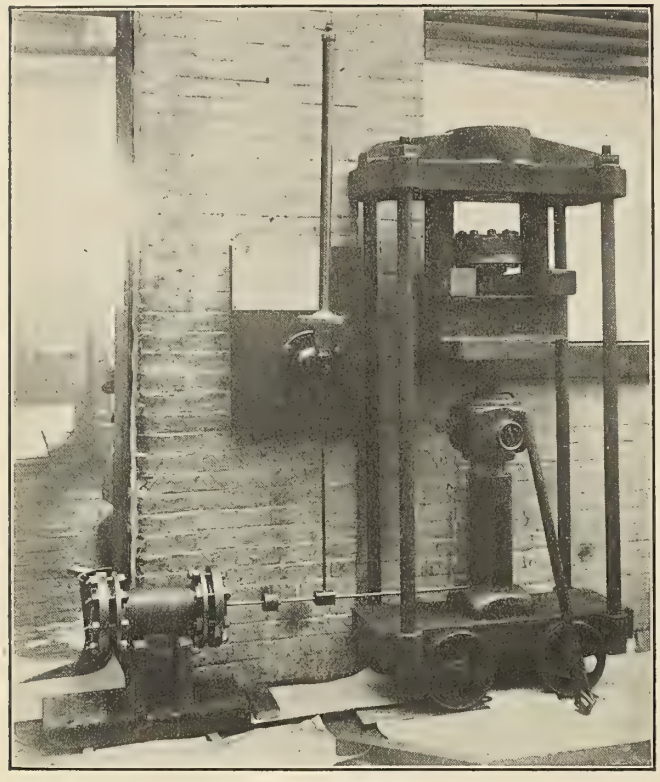


FIG. 2. APPARATUS READY FOR TESTING.

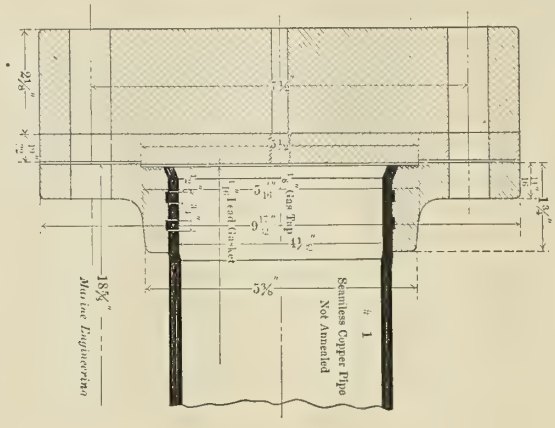
of the test pipe in contact with the equalizing plate and frame resting on the under side of the top plate of the press, thus pulling the pipe apart or out of the flanges as the results show; the pressure in the jack being read, as before, on the gage, and from the pressure the total tons load was read off a table calculated for every 100 pounds per square inch on the jack ram, this ram being of 4 13-16 inches diameter.

By agreement with Naval Constructor Powell and Captain Bergdorff no allowance was made for the weight of the ram, frame, and test piece, in the results of the pulling tests, as the readings taken from the gage were not close enough to consider such refinements. In order to fully satisfy the inspectors and their departments as to the accuracy of these instruments, Mr. Powell sent his assistant to the place of manufacture to test them. On Friday, February 17, we placed these gages under all manner of tests, comparing them with Bourdon spring gages, and other mercury test gages, and finally placed them in connection with a plain mercury column which measures exactly 68 feet and 7-8 inch high; calling 2.04 inches of mercury equal to 1 pound pressure, this equals 400.4 pounds; the gages tallied exactly with this pressure, and fully satisfied the inspector as to their accuracy.

Accurate full-size drawings have been prepared of each test piece, the numbers on the same corresponding with the order in which the tests were made. A photograph of all the test pieces is also shown, in Figure 1.

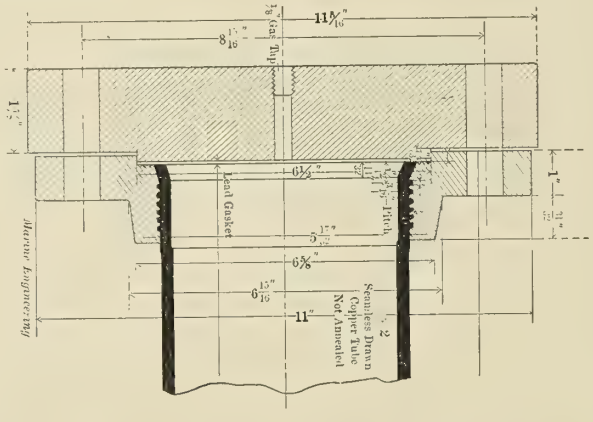
On Tuesday, February 14, previous to making the tests, the large expanding machine, capable of working pipe 30 inches diameter, was placed in operation and fully explained to all present, a piece of 20-inch wrought-iron pipe being expanded, flared, and faced complete in 32 minutes.

Piece No. 1 was of 4 inches inside diameter, seamless copper tube, 3-16-inch thick, unannealed, expanded in drop-forged steel flanges furnished by the New York Shipbuilding Company; the flanges are a standard design used for 100 pounds working pressure, as shown on figure. This was given a hydraulic test and everything was perfectly tight until 3,200 pounds per square inch was reached, when it began to leak at the gasket, but the pressure was increased to 3,600 pounds, after which the test was stopped; the expanded joint was perfectly tight, and apparently the flanges had not started off the pipe, although after disconnecting they were found to be loose on the pipe, the metal in the flange having been strained beyond the elastic limit. This gave a factor of safety of 36 for this piece, as compared with the working pressure.



This same piece was re-expanded and given a pulling test on February 16, one flange starting to pull off the pipe when 24.73 tons was reached; this corresponds to 4,300 pounds per square inch internal pressure in the pipe, and gives a factor of 43 as compared with the working pressure. Complete rings were sheared off the copper in the grooves in flange.

Piece No. 2 was of 5 inches seamless drawn copper tube unannealed, 1-4-inch thick, expanded into forged steel flanges furnished by the Scully Steel and Iron Company, of Chicago, as used for 200 pounds working pressure; all as shown on figure. On February 14 this was given an hydraulic test; everything was perfectly tight until 1,800 pounds was reached, when it began to leak in the expanded joint and started one flange off the pipe. This gave a factor of 9, but pipe was not fully expanded.



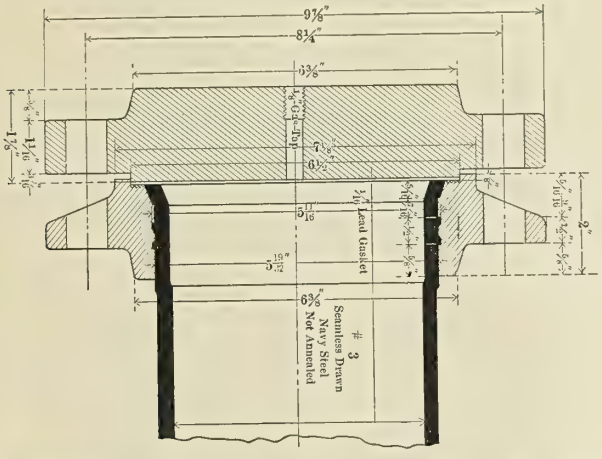
This was re-expanded and again given a second hydraulic test, on February 16, when 2,800 pounds was the maximum, when it began to leak at the gasket, the expanded joint remaining perfectly tight; this gave a factor of 14. It was again given a pulling test on this date, without expanding, starting one flange off the pipe when 15.18 tons was reached. On removing the flange the joint shows that the metal had not flowed well into the grooves, only two out of the six rings were holding, and these were only partly filled with the copper. This accounts for the low pressure this piece stood. This type was purely an experimental joint.

Piece No. 3 was of high grade, seamless drawn steel tube, the same as used for high-pressure steam by the United States Navy Department; it is 5-inch pipe, 17-64-inch thick, and was expanded, unannealed, into forged steel flanges of an entirely new design suggested by Mr. Lovekin; flanges were furnished by the New York Shipbuilding Company, as shown on figure. This

was intended for high pressures, up to 300 pounds per square inch; all calculations for design are fully shown in figure. On February 14 this was given an hydraulic test; on reaching 600 pounds it began to leak slightly in the gasket, but the pressure was increased to 3,800 pounds, when leak in gasket overcame the pump supply and test was stopped. The expanded joint was perfectly tight. This gave a factor of 13. (See later tests.)

On February 15, new lead gaskets 1-16-inch thick were applied in place of the copper, and a second hydraulic test given the piece. Four thousand three hundred pounds was reached when it began to leak again at the gasket, the expanded joint remaining perfectly tight.

On February 16 the bolts were tightened up and pressure again applied. At 4,800 pounds one flange was drawn off the pipe about 1-2 inch; again applied pressure to force the flange entirely off, and it again stood 950 pounds without a leak. In the first test on this the expanded joint was perfectly tight until flange started to pull off the pipe. This gave a factor of 16. On removing the flange it was found that the metal had flowed very little into the grooves in the flange, while the flaring was perfect. This was due to the metal in the pipe not being annealed, and the flange having no backing whatever to support the same.

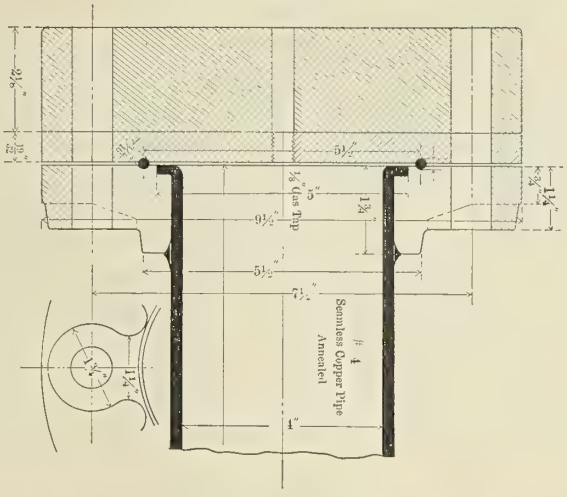


On February 20, wishing to remove the flange that remained intact on the other end of this pipe, there was applied all the pressure a man could exert on a 40-ton jack, in the opposite direction to the pulling tests, and managed to start the pipe in the flange about 1-64 inch, and finally had to cut the tube out with a chisel and hammer. In cutting this tube where it had been expanded, the metal was very hard and tough, and was not in the least flaky or brittle; showing the expanding had not lessened the strength of the material to any appreciable extent, and that no crystallization had taken place.

Piece No. 4 was of 4-inch seamless drawn copper tube 3-16-inch thick, hammered, beaded over, and brazed into composition flange by New York Shipbuilding Company, and in a 200-pound joint; all as shown on figure. On February 14 this was given an hydraulic test and began to leak at the gasket at 1,800 pounds, but the pressure was increased to 2,200 pounds, when leak increased beyond the capacity of the pump. The pipe began to bulge at 600 pounds, near the brazing at each end, and reached the elastic limit of the metal at 900 pounds. The pipe was stretching lengthwise all the time; it was very much distorted at 2,200 pounds. Elongation was 1-8 inch and increase in diameter 1-4 inch. This gave a factor of 11, but the elastic limit was reached with a factor of 4.

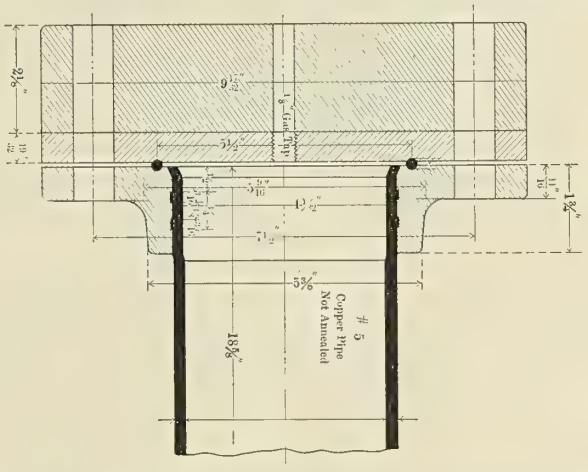
This piece was also given a pulling test, and the pipe pulled apart about 1 inch from the flange at 29 tons; this corresponds to an internal pressure of 5,000 pounds per square inch. During this test the pipe increased in length 2 9-32 inches and decreased in diameter 7-16 inch. The brazing was cracked at each end.

Before this test there were some comments on this test piece, by one of the supervising inspectors, to the effect that this pipe



appeared to have been overheated in brazing, and that it was not a fair example of brazed work. After the test the pipe at the fracture was hammered down, in an effort to break some pieces off; but it was impossible to do so, showing the life of the copper to be unimpaired.

Piece No. 5 was of 4-inch seamless drawn copper pipe, 3-16-inch thick, unannealed, expanded into forged steel flanges, furnished by New York Shipbuilding Company, and is a fair sample of joint for 100 pounds, as shown on figure. On February 14, those present requested that the pipe be given a pulling test to compare with the pulling test on the brazed joint No. 4. This was stated to be hardly a fair comparison, as this sample was

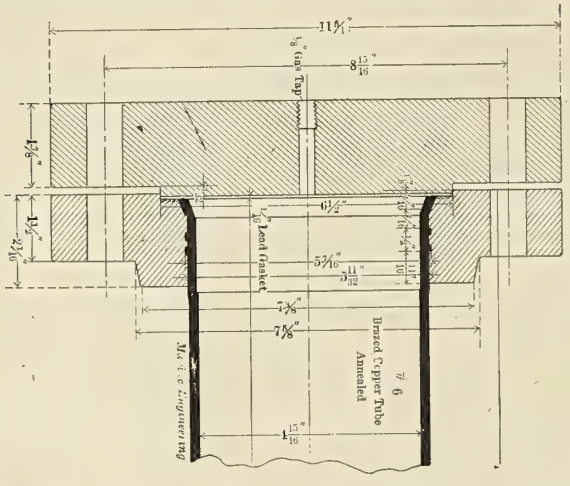


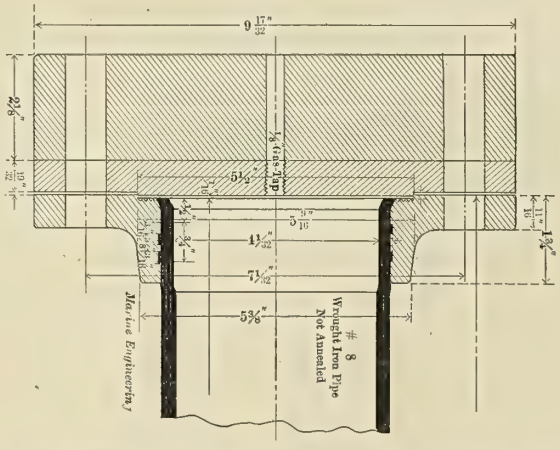
not designed for a great pulling load or high pressures, and being expanded would not compare with No. 4, which was practically one solid piece of metal; but to the surprise of every one it stood 28.17 tons, when one flange started off the pipe, shearing complete rings off the copper pipe in the grooves in the flanges. This was equal to an internal pressure of 4,940 pounds per square inch and gives a factor of 24.7; this is .83 ton less than the brazed sample No. 4.

Piece No. 6 was of 5-inch brazed copper pipe, annealed, 3-16-inch thick, expanded into cast-iron flanges, furnished by Dienelt & Eisenhardt, and was intended for 200 pounds working pressure, being shown on figure. On February 16, this was given a pulling test and pulled the pipe apart in one flange at 34.36 tons; this is equal to an internal pressure of 3,850 pounds per square inch, and gives a factor of 19. The expanding was perfect. To see what initial strain, if any, was set up, due to expanding the pipe into the cast-iron flanges, they were removed from pipe, laid on the floor, and struck with a 16-pound sledge swung by a very strong man, and it required two or three blows to crack them, thus giving ample proof that the initial stress set up in the flange was not sufficient to materially weaken the same.

SUMMARY OF TESTS.

Piece No.	Inside Diameter of Pipe.	Thickness of Pipe.	Material.	Kind of Joint.	Designed Working Pressure.	Kind of Test.	Hydraulic Pressure per Square Inch.	Pulling Load in Tons.	Internal Pressure per Square Inch Corresponding to Pulling.	Factor Comparing Destructive Pressure with Working Pressure.	Remarks.
1	4″	3/16″	Seamless copper.	Expanded.	100 lbs.	Hydraulic.	3,600 lbs.	.....	....	36	Leaked in gasket. Perfectly tight in expanded joint. Flanges loose on pipe.
1	4″	3/16″	"	"	100 "	Pulling.	....	24.73	4,300 lbs.	43	One flange off pipe. Was re-expanded for this test.
2	5″	1/4″	"	"	200 "	Hydraulic.	1,800 lbs.	.....	....	9	Started one flange. Leaked in expanded joint.
2	5″	1/4″	"	"	200 "	"	2,800 "	.....	....	14	Was re-expanded. Leaked in gasket. Otherwise tight.
3	5″	17/64″	Seamless steel.	"	300 "	"	3,800 "	.....	....	12.7	Leaked in gasket. Otherwise tight.
3	5″	17/64″	"	"	300 "	"	4,300 "	.....	....	14.3	Leaked at new gasket.
3	5″	17/64″	"	"	300 "	"	4,800 "	.....	....	16	Expanding tight. Pulled one flange loose.
4	4″	3/16″	Seamless copper.	Brazed.	200 "	"	2,200 "	.....	....	11	Bulged very badly. Leaked at gasket. Elastic limit reached at 900 lbs.
4	4″	3/16″	"	"	200 "	Pulling.	....	29	5,000 lbs.	25	Pulled apart 1″ from brazed joint. Brazing cracked, flanges dished.
5	4″	3/16″	"	Expanded.	100 "	"	....	28.17	4,940 "	24.7	Pulled one flange off pipe.
6	5″	3/16″	Brazed copper.	"	200 "	"	....	34.36	3,850 "	19.2	Pulled pipe apart in flange.
7	5″	17/64″	Seamless steel.	"	200 "	"	....	32.98	3,700 "	18.5	Pulled one flange off pipe.
8	4″	1/4″	W. I.	"	100 "	Hydraulic.	2,000 lbs.	.....	....	20	Re-expanded. Pulled one flange off pipe.
8	4″	1/4″	W. I.	"	100 "	"	3,300 "	.....	....	33	Expanding tight. Leaked at gasket.
9	4″	1/4″	W. I.	"	100 "	"	3,100 "	.....	....	31	" " " " "

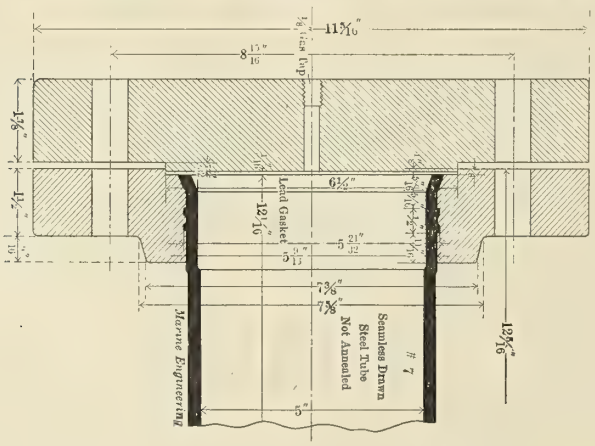


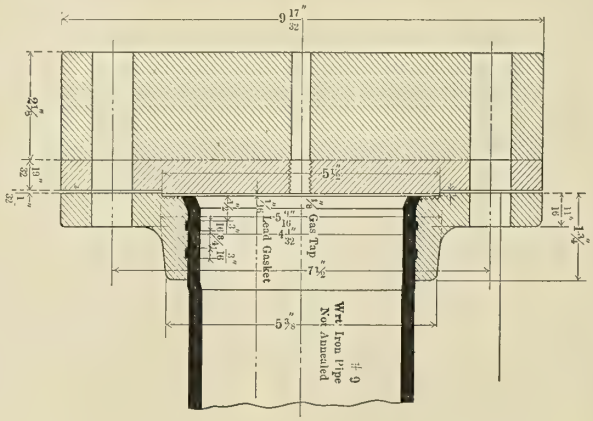


Piece No. 7 was of 5-inch seamless drawn steel tube, 17-64-inch thick, unannealed, expanded into cast-iron flanges, furnished by Dienelt & Eisenhardt, and intended for 200 pounds working pressure. On February 16, this was given a pulling test and started one flange off the pipe at 32.98 tons; this corresponds to an internal pressure of 3,700 pounds per square inch and gives a factor of 18.5. The expanding was perfect, but the metal flowed into the flange grooves very little. The hammer test to crack the flanges gave the same results as with No. 6.

Piece No. 8 is of 4-inch standard wrought-iron pipe, about 1-4-inch thick, expanded into forged steel flanges, furnished by the New York Shipbuilding Company, and is a standard 100-pound pressure joint. This had been re-expanded, the flanges having been loosened from a previous preliminary test. On February 16, this was given an hydraulic test, and was perfectly tight in the expanded joints up to 2,000 pounds per square inch, when it began to leak and started one flange off the pipe. This was not to be accepted as to what the joint would stand if new, as it was made to find out what a joint would stand after it had been excessively strained, so as to loosen the flanges and re-expanded again, and for this purpose shows exceedingly good results.

In preparing for these tests preliminary trials were made on February 11 and 13 on pieces No. 8 and 9 (see figures here-





with) to determine how the gaskets would hold, also the strength of the light forged steel blank flanges, and these results show what pressure this type of joint will stand when new. Pieces No. 8 and No. 9 are 4-inch standard wrought-iron gas pipe, about 1-4-inch thick, expanded into forged steel flanges, furnished by the New York Shipbuilding Company, and intended for 100 pounds working pressure. Piece No. 8 stood 3,300 pounds hydraulic pressure with expanded joint perfectly tight, but leaking at the gaskets. Piece No. 9 stood 3,100 pounds hydraulic pressure with expanded joints perfectly tight, but leaking at the gasket. In both tests, after disconnecting, the flanges were found to be loose on the pipes, showing the limit of elasticity of the flange had been reached; this gives factors of 33 and 31.

Under these tests the blank flanges bulged about 3-16 inch, and it was found necessary to add the cast-iron flanges, shown on the drawings, to strengthen them and prevent the excessive springing. In all the hydraulic tests the pressures were not put on and released instantly, but wherever the joint did not pull apart it was kept at maximum for several minutes. In the table is a tabulated summary of these results for reference and comparison.

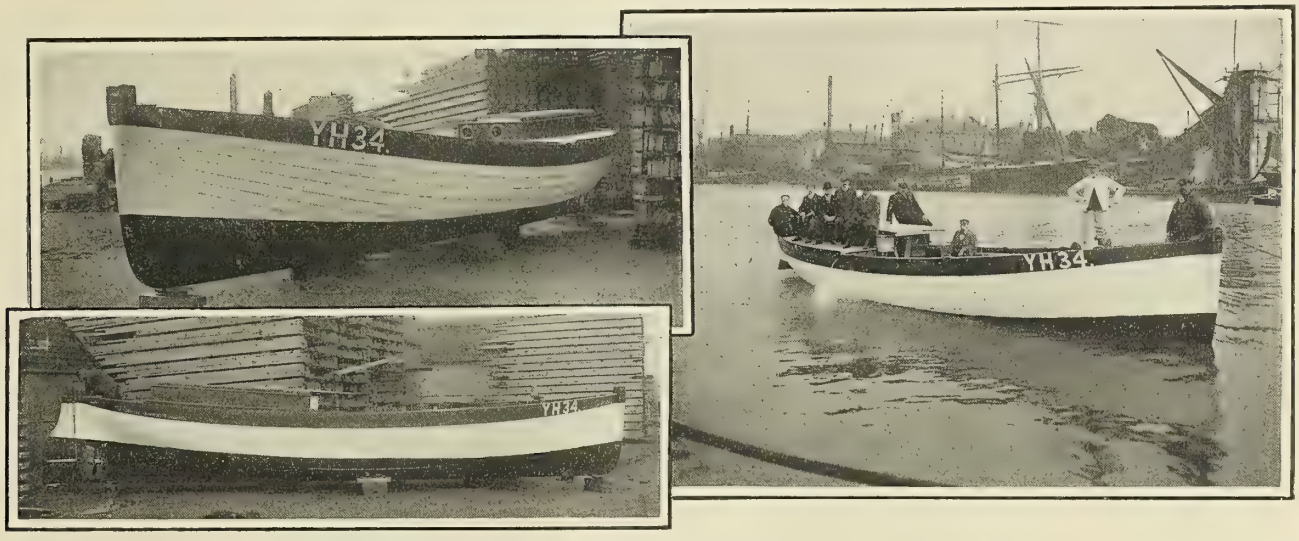
obtained by promotion from the last mentioned, and the position is that of a warrant officer.

There is frequently a demand for boiler makers in the navy, though at the present time the navy is pretty well supplied with men of this rating. The pay is $65 per month, and applicants for enlistment must be competent boiler makers by trade; if they have had previous sea experience that fact will operate to their advantage. The same may be said of blacksmiths, for whom the pay is $50 per month.

It is needless to state, of course, that all men on sea duty are furnished with food, lodging, and medical attention free of charge, and that a free outfit of clothing is furnished every enlisted man of the navy on the occasion of his enlistment.

Motor Fishing-Boat Reaper.

This boat was built at Great Yarmouth, England, for Mr. H. Johnson, of Sheringham, and is used for fishing purposes in general. Previous boats for fishing and "whelking" have been of about 13 feet in length and propelled by lug sails. This boat has been built to reach the outside part of the territory, and at the same time to do a little trawling. She measures 34 feet on the keel and 36 feet over all, with a beam of 9 feet 9 inches, and a depth of 3 feet 11 inches. In order to be able to make use of shallow harbors along the coast the boat has the small draft of 2 feet 6 inches. There is an oak keel 4 1-2 inches wide, with pine keelsons and 1-2-inch oak planking.



THE MOTOR FISHING-BOAT REAPER.

The engine is of 15 horsepower, of the Gardner kerosene pattern, with two cylinders each having a bore of 5 1-4 inches and a stroke of 6 inches. The revolutions per minute are 700. A Gaines reversible propeller is fitted, and is so arranged that low speed can be obtained with it without slowing the engine, by placing the blades in a nearly neutral position. The expected speed of the boat was from 7 to 8 miles per hour, but no difficulty is experienced under good conditions in making 9 miles, while at one time, in a hard gale, she made 10 miles against the sea in just under 1 1-2 hours.

Openings in the United States Navy.

We are informed by the Navy Department that there is a considerable demand in the service for machinists and machinists' mates, these of course gradually leading up to the grade of warrant machinist.

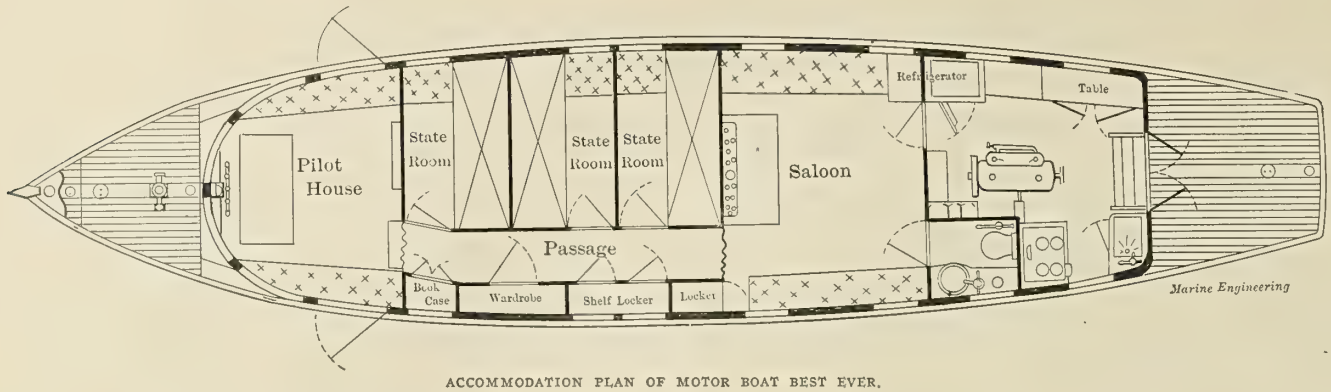
Machinists' mates of the second class must be machinists by trade, familiar with the names and uses of the various parts of marine engines and boilers, able to perform work with the various tools in the machine shop, including bench work, and must be able to write legibly and have some understanding of arithmetic. Candidates for this class, who are not required to have any experience at sea with marine engines, will be assigned to duty as water tenders and oilers. The pay for this class is $40 per month.

Machinists' mates of the first class, whose pay is $55 per month, must have the same qualifications as those of the second class, and in addition must have had experience at sea with marine engines for a period of at least one year. Those of the second class are promoted to the first class as soon as eligible.

Chief machinists' mates, whose pay is $70 per month, obtain their rank by promotion from the other two ranks as occasion offers, it not being considered policy to enlist anyone with this rank unless he has previously earned the rank on a permanent appointment.

Warrant machinists are paid from $1,200 to $1,800 per annum, according to length and condition of service. This rating is

Chief-engineer Charles A. McAllister, of the revenue cutter service, who has been temporarily holding down the chair of engineer-in-chief during the illness of Capt. John W. Collins, was recently appointed engineer-in-chief permanently upon the retirement of Capt. Collins. Mr. McAllister has the distinction of being the youngest officer who ever held this important post, and it is the universal testimony of those with whom he has been intimately associated in his work that he is in all respects qualified to properly discharge the duties devolving upon him.



ACCOMMODATION PLAN OF MOTOR BOAT BEST EVER.

The Motor Boat Best Ever.

The drawings of the motor boat *Best Ever,* owned by Mr. H. S. Peters, of Dover, N. J., and built by Hiram Weller's Sons, of Trenton, N. J., show a boat with a length over all of 48 feet 6 inches, a beam of 10 feet 6 inches, and a draft of 2 feet 10 inches, with 5 feet 6 inches freeboard at the bow and 2 feet 7 inches minimum freeboard. This craft was designed as a safe and comfortable family cruiser for work in all kinds of weather, which accounts for the considerable beam, and for the fact that the midship section is quite flat, thus allowing the light draft and permitting operations in shallow waters. It will be noticed from the accommodation plan that three staterooms are provided, each of which has upper and lower berths, with a chest of drawers under lower, while the sofas in both pilot house and saloon could, if necessary, be utilized for sleeping accommodations. The pilot house, 6 feet 9 inches long, has an outlook in all directions, while under it are the water tanks. The platform for the wheelman is also fitted up to be used as a chart locker under the grating. The main saloon, which occupies the full width of the boat, has a length of 7 feet 5 inches and carries at the forward end a folding table hinged to the forward bulkhead; beneath this table are drawers for table linen, cutlery, etc., while above is an oak mantel arranged for the reception of glasses. At the after end of the saloon the built-in refrigerator extends through the bulkhead into the galley, and serves the purpose of a small sideboard.

BEST EVER.

Galley and engine room are combined in one. At the forward end is the refrigerator above mentioned, which has a capacity for 150 pounds of ice, and drains overboard. The range, which is heated with coal, is on the port side just abaft the toilet room opening from the saloon. Propulsion is provided by a Palmer four-cycle, 12-horsepower engine, operating a 24-inch, 3-blade propeller at 375 to 400 revolutions per minute. This power is found to be sufficient for a continuous speed of 7 knots under all ordinary conditions of weather; the best speed under favorable circumstances being about 8.5 knots. The exhaust from the engine is carried outboard on the port side between the range and the toilet room. The boat is lighted throughout by electricity furnished by a dynamo belted to the engine. Gasoline is carried in a cylindrical galvanized steel tank under the forward deck, the capacity being ninety gallons, which is found to be sufficient for a run of about sixty hours, or 450 miles. The watertight bulkhead abaft gasoline tank prevents leakage into the bilge.

This very serviceable little craft has been in operation upward of a year, having covered nearly five thousand miles in her first season, from the Great Lakes and St. Lawrence River on the north to Florida on the south, and has proved herself, by repeated tests, a very seaworthy craft. On one occasion, with the engine slowed down and seas coming across the bows pretty regularly, which is what an ordinary sea will not do, she ran nine miles in two hours against a wind which was reported by the United States Weather Bureau to have had a velocity of from sixty-eight to seventy miles per hour.

The interior is of white pine in natural finish, the outside of the cabin being of cypress with mahogany finish, the plank shears and sprayboards of oak, the deck of selected white pine in narrow widths, the upper deck being covered with canvas. Masts are fitted, carrying leg-o'-mutton sails, for use when occasion demands, and are arranged for rapid dismantling.

The Insufficiency of Marine Feed Cleaners.

BY DAGNINO ATTILIO.

Feed-water filters, as used for marine purposes, very rarely come up to the requirements of the situation. The fact was brought out some time ago in a meeting of the A. S. M. E. that there were no satisfactory filters at that time in use, and conditions have not improved since. It is a fact, however, that when one is willing to incur the expense of installing an appropriate filtering plant, no trouble is experienced with regard to the proper filtering out of the oil from the feed water taken from surface condensers. To cite a case in land practice, a large electric light and power plant in Chicago has been using feed water from surface condensers for more than six years without having any trouble whatever, because of the fact that the filters provided are amply large and properly constructed. It is true that they are quite elaborate and require considerable space, but they obtain the desired result and save large water bills.

At sea many systems are in use, but all appear to need considerable attention and some seem to require cleansing every day. Most of the transatlantic steamers take the feed water through filter tanks filled with coke, sponge, salt, hay, or excelsior, after which it is passed through some patent device before being fed to the boilers. In the new Italian battleship *Regina Margherita* there are four filters of the Harris type, besides a feed-water cleaner inside the feed-water tanks, the total serving for a steam machinery plant of 20,000 horsepower weighing 1,500 tons. The cleaner in the tanks was installed after tests made without it, at the conclusion of which the water surfaces in the boilers were found to be covered with a considerable stratum of grease.

A large part of the trouble is caused by the fact that when

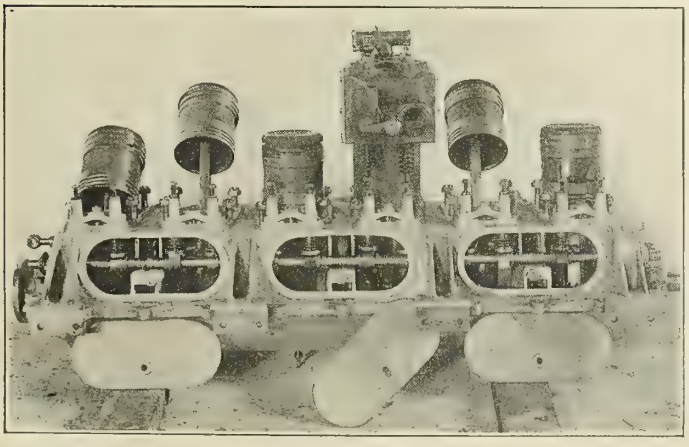
an engine is first started up oil is used very liberally in the cylinders, particularly when heavy loads are carried at the beginning. The excess of oil chokes the filter and trouble with the boilers immediately ensues. If a little care were used at the start not to use water from the filters until the cylinders and valve surfaces of the engine were in good condition with regard to lubrication, no such trouble would be experienced; but even after that a minimum amount of oil should be employed. As a rule, engineers use more oil than is necessary, and in many cases the oil used is of a very poor quality. The ideal arrangement would be, of course, the use of no oil whatever.

In modern warship practice the reserve feed water is necessarily a small quantity, while the water consumed in the boilers in a given length of time is frequently a considerable amount. If, then, the feed water at the start be drawn entirely from the tanks rather than from the filters, the reserve supply will suddenly disappear. In a case like this the question of using a very small quantity of oil is of great importance, and it is frequently found possible to do away with oil in auxiliary machinery, particularly in pumping machinery, where the steam furnishes a sufficient film for lubrication.

On shipboard, where the space is very limited, it would seem that the only satisfactory solution where filters must be used is the development of some form of chemical filter which will separate the grease from the water in a ready manner, and do it in a small space. The subject is one of great importance, and has yet had no satisfactory solution.

A New Motor Boat.

Built by the Olds Motor Works, of Detroit, with its hull designed by Professor H. C. Sadler, a new motor boat which has recently made its appearance on the Detroit river measures 35 feet in length, 4 feet 6 inches in breadth, and 2 feet 3 inches deep. She is built with a double skin, the inner one being 1-8 inch thick and the outer 3-16 inch mahogany. Except under the weights of the engine space the frames measure 1-2 inch by 3-4 inch. The keel is of white oak in one piece, and the engine floors and beams are also of oak, being continued for some distance aft of the engine space by a gradual taper, thus giving the vessel a very stiff bottom. The decks are made of 3-16-inch mahogany.



The motor is of the six-cylinder vertical type, as shown by our illustration, which gives a view with only one cylinder in place, the other pistons being visible at various angles of inclination. The intake and exhaust valves are side by side; the crank case is made of aluminum with bronze bearings for main shaft. The six-throw crank is of nickel steel, carrying at the front the flywheel and at the rear a flange bolted to the short section of shafting carrying the transmission gear. The reciprocating parts are well balanced and at 1,000 revolutions per minute very little vibration is apparent. The power developed is between 50 and

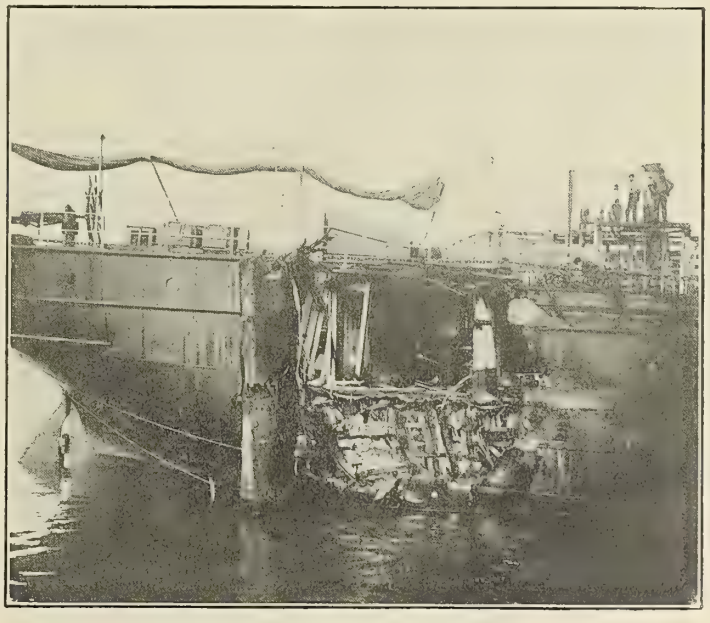
THE OLDS MOTOR BOAT ON TRIAL.

60 horsepower with cylinders measuring 5 by 5 inches. A single carbureter is fitted for the six cylinders and the ignition is of the high-tension type, by means of accumulator and spark coil. The boat has made a little more than 20 miles per hour on the river, and is expected to do still better with the improvements which observation and experience will be sure to suggest.

Collision Between the Kentucky and the Exeter City.

On May 27 the British steamship *Exeter City,* which had just left this port for Bristol, came into collision with the incoming Scandinavian-American liner *Kentucky,* and was so badly damaged that she had to put back for repairs. The occasion of the collision was a heavy white fog which made it impossible for ships to see more than a few feet in advance of their bows. As a result of the blow, which was a glancing one, the after plating on the starboard side of the *Exeter City* was sheared off for a distance of about 15 feet, and, as may be seen in the illustration, was rolled back upon itself in a very peculiar manner. The quarters which were thereby exposed to view are those of the captain. The steamer was repaired in the Erie Basin.

The *Exeter City* measures 285 feet in length, 38 feet in beam, and has a depth of 23 feet 6 inches. Her tonnage is 1,359 net and



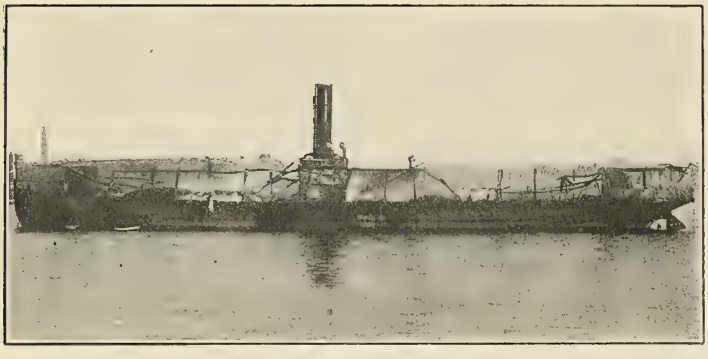
THE EXETER CITY AFTER THE COLLISION.
(Photo by N. Y. Herald.)

2,140 gross. She was built in 1887 by the Blyth Steamship Company, of Blyth, England, and the hull is sub-divided by six steel bulkheads. She is propelled by a triple-expansion engine with cylinders measuring 22 1-2, 37, and 61 inches in diameter and a stroke of 42 inches. The *Kentucky* is also a steel screw steamer measuring 329 feet in length, 45 feet in beam, and has a depth of 32 feet 6 inches. Her tonnage is 2,351 net and 3,622 gross. She was built at Copenhagen in 1897 by Burnester & Wains. She is propelled by a triple-expansion engine with cylinders measuring 24, 40, and 64 inches in diameter, with a common stroke of 42 inches.

Burning of the Steamer Mohawk.

In striking comparison with the total loss in New York harbor by fire of the wooden excursion steamer *General Slocum,* is the damage sustained on the night of November 18, 1904, by the freight steamer *Mohawk,* running from New York to New London. The hull of the *Mohawk* is built of steel throughout up to the main deck, which is also of steel, and it is due to this fact that the furious fire which broke out forward, and rapidly consumed the cargo and wooden upper works, did not completely destroy the vessel.

The *Mohawk* had nearly completed the run to New London, when smoke was noticed issuing from the forward hatch. The vessel was at once stopped in order to lessen the risk of flames spreading (because of the draft of air resulting from the boat's motion), and the fire-fighting apparatus was quickly brought into action. The crew were unable, however, to check the flames, which were spreading rapidly in the inflammable cargo, and within an hour from the time the fire was discovered they had to abandon the ship. The steamer *Boston,* of the Fall River line, which was standing by to render assistance, picked up all of the men but one of the bow watchmen, who perished in his bunk.



THE WRECK OF THE MOHAWK.

The wind and tide carried the burning ship over to the Long Island shore. When the flames had died down the wrecked vessel was towed to an anchorage on the Thames, where the above photograph was taken.

It will be noticed how completely the upper works were consumed. All cargo on main deck and in forward and after holds was burned, and sparks falling down the coal chute ignited the coal in the bunkers. While the heat down below was sufficient to burn every vestige of wooden ceiling in the engine room, the only serious damage to the machinery was a cracked low-pressure cylinder and a few sections of shafting which had to be replaced. The comparatively slight damage sustained is attributed to the fact that no sea water reached the heated pieces. The hull was practically not damaged, but several of the deck plates had to be replaced or straightened.

The contract for repairs, which included a general overhaul of machinery, was placed with the John N. Robins Company, Erie Basin, Brooklyn. The *Mohawk,* which was built at Chester, Pa., in 1896, is of the following general dimensions: length between perpendiculars, 265 feet; beam, molded, 43 feet; depth, 16 feet 8 inches; net tons, 2,151. There is one triple-expansion engine with cylinders 21, 34, and 56 inches diameter by 42 inches stroke, supplied by Scotch boilers, with steam at 160 pounds pressure.

After being almost completely rebuilt, the *Mohawk* has resumed her regular service between New London and New York.

The Mishap to the Zambesi.

The British freighter *Zambesi* left Savannah, Ga., on the 2d of January bound for Bremen, with a cargo which included 750 bales of cotton and 2,700 tons of phosphate rock. Before many hours had passed she was in collision with a derelict which sat so

THE INJURED BOW OF THE ZAMBESI.

(Photo by Hall.)

low in the water that it was not seen until too late to avoid the catastrophe. The bow of the *Zambesi* was smashed in, as shown by the accompanying photograph. It will be seen that the stem was broken squarely off in two places, the upper break being at a draft of 21 feet, and the length of the separated section corresponding with the width of the strake of side plating to which it was attached. The forward collision bulkhead saved the ship from any serious danger on the question of foundering. The damage was so serious, however, that it was decided by Capt. Rooney to proceed at once to New York for repairs. The second morning following it was discovered that the cotton in the forward hold was on fire. Live steam was immediately turned into the hold and all vents closed, and the ship proceeded on her way in a gale of wind, with a seriously damaged bow and a burning cargo. The next morning a third form of disaster came near materializing when it was discovered that the relief crew, asleep in the forecastle, were unconscious from suffocation, believed to be due to gas generated from the sulphate rock by the heat of the burning cargo. They were finally revived by means of a mustard emetic and the ship reached port without further mishap.

The photograph was taken in the Erie basin, where the ship has been sent for repairs.

The *Zambesi* was built in 1901 by Bartram & Sons, in Sunderland, England. She is a steel screw steamer, schooner rigged, measuring 350 feet 1 inch in length, 46 feet in beam, and 25 feet 8 inches in depth. The tonnage is 2,415 net and 3,727 gross. Six watertight bulkheads divide the ship into seven compartments, as a security against accident. The machinery consists of one three-cylinder, triple-expansion engine, the cylinder diameters being 24 1-2, 40, and 66 inches, with a common stroke of 45 inches.

The Year's Shipbuilding in the United States.

The Department of Commerce and Labor, through its Bureau of Navigation, reports that in the fiscal year ended June 30, 1905, there were built in the United States 1,301 vessels of a total of 326,213 tons gross, as compared with 1,308 vessels of a total of 401,417 tons gross for the year ended June 30, 1904; while the construction for the year ended June 30, 1903, was 1,535 vessels of 456,076 gross tons, and for the year ended June 30, 1902, 1,657 vessels of 473,981 gross tons. This record shows the continuous decline in mercantile shipbuilding during the present decade.

Of the ships constructed during the last fiscal year, only 42, of 56,777 tons, were steel steamers for ocean traffic, as compared with 51 last year of a total of 99,192 tons, and it is needless to state that aside from the mammoth *Dakota* and *Minnesota* these ships are for coasting trade.

Of the total this year 978, of 101,936 tons, were wooden vessels, and 76, of 161,128 tons, steel vessels propelled by sail or steam; while 247, of 63,149 tons, were barges. The vessels propelled by sails numbered 362, of 74,503 tons; and the steamers 692, of 188,561 tons.

The Milan Exposition of 1906.

To commemorate the opening of the new Simplon Pass through the mountains separating Switzerland and Italy, it is proposed to hold an exhibition under the patronage of the King of Italy in the city of Milan. One of the sections of this exhibition will be devoted to "carriage by water," and is composed of three divisions, the first of which relates to maritime transportation, with its various branches of shipbuilding, fitting-out, equipment, navigation, ports, etc. The second is devoted to inland water carriage, with exhibits of types and methods of operation of river boats, and different systems of traction. The third is concerned with sea and fresh-water fishing and similar industries.

The directors have furnished us with a limited supply of circulars, which we will be pleased to furnish to those interested, upon request.

An Enormous House Cleaning.

The British Admiralty has recently caused a large amount of comment by condemning and offering at public auction more than 150 warships of various classes, which were estimated to have outlived their usefulness, and to put a larger charge upon the public revenue than their value warranted. Nearly all of these ships were more than twenty years old, but quite a number dated from the nineties, and two small cruisers were launched as recently as 1896 and 1897. It is interesting to note that the entire list includes 12 old battleships, 9 armored cruisers, 15 protected cruisers, 75 unarmored cruisers and gunboats, and nearly 30 vessels of miscellaneous type, the total displacement of the fleet having been quite 350,000 tons. It is estimated that the construction cost of these ships was in the neighborhood of $90,000,000, while the prices received represent, of course, simply the value of the old iron and other materials of construction. One condition of the sale provides that the ships be immediately broken up, which means that they cannot possibly fall into the hands of any other naval power.

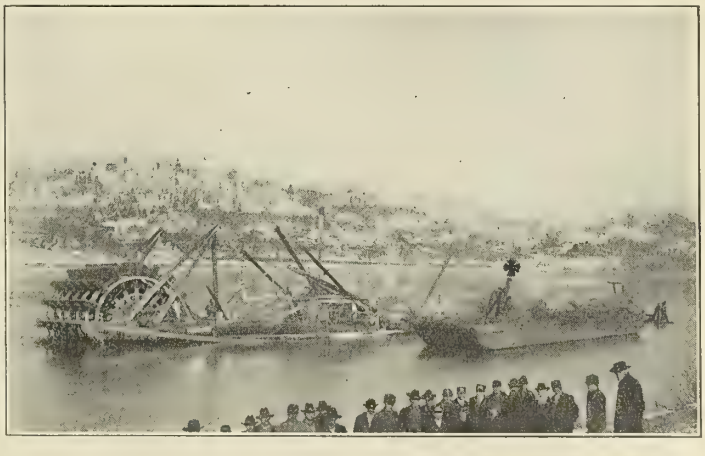
The Burning of the Tow-Boat Defender.

On the night of January 3, the boilers of the tow-boat *Defender*, operating on the Ohio River, and then near Huntington, W. Va., exploded, resulting in the complete destruction of the boat by fire, the killing of ten out of a crew of thirty-six, and the injury

THE DEFENDER IN SERVICE.

(Photo by the Barrette Portrait Co.)

of all but one or two of the remainder. The exact cause of the explosion has not been determined with any degree of certainty, though the conclusion reached at the time of the inquest was that the boiler plates were at fault on account of the rules at present in vogue for their manufacture. The requirements are that a plate must show a tensile strength of 70,000 pounds per square inch, and that a specimen measured for a length of 8 inches must show an elongation of 25 percent and a reduction in area of 50 percent. It is claimed by the steel makers that the requirements in the way of tensile strength are at least 10,000 pounds too high, the idea being that the higher tensile strength conduces to brittleness in the plate with consequent inability to withstand the strain of the continual variations in temperature to which a boiler plate in use is subjected.



THE DEFENDER IN RUINS.

We present two photographs, one showing the *Defender* before the explosion, and the other showing the wreck as it appeared the next morning. In the second case a cross has been placed on the photograph indicating the position of the boilers on the boat.

The *Defender* was formerly known as the *S. L. Wood*. She was built in 1881, at Pittsburg, by the Wood Coal Company. The hull was 177 feet in length, 41 feet in beam, and 7 feet 3 inches in draft, the tonnage being 514.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

The edition of the August issue of Marine Engineering comprises 5,500 copies. We have no free list, accept no return copies and issue only enough to supply the regular demand, so that the 5,500 copies represent legitimate circulation.

Lake Shipping of the United States.

We are publishing this month two articles dealing with different phases of what has come to be by far the largest part of the shipping industry of the United States. These two phases may be said to be mutually to a certain extent a case of cause and effect, for certainly the tremendous impetus which shipping on the Lakes has received during the past quarter of a century or more could not have been attained were it not for the magnificent equipment of labor-saving devices of all sorts installed at the various ports for the operations of embarkation and debarkation of the ore, coal and grain which forms so large a part of the entire trade; on the other hand, the immensity of the traffic which called for so intense a production of labor-saving devices could not have attained anything like its present proportions without the intervention of some such means of communication between Lake Superior and the lower lakes as that afforded by the great ship canal and locks at Sault Ste. Marie.

A semi-centennial of the opening of the first of these locks for service is, as we have stated in another column, to take place in the early days of August of this year, and it commemorates not only the mere fact of having opened up a water way for the passage of immense quantities of freight, but at the same time the opening up of a water way which has been very potently instrumental in the development of what might without exaggeration be called an empire. The great grain fields of the Northwest, together with the mammoth mining resources, for iron particularly, but also for coal, have called for an outlet which could have been furnished by the railroads only at an almost prohibitive outlay in expense for freights, whereas the shipping which has been devoted to the purpose of removing the products of the soil has been found to give this service at a cost of considerably less than one mill for every mile each ton of freight was moved.

To give an idea as to the immense growth which has taken place in the traffic to and from Lake Superior during the past forty or fifty years, we have merely to point out that in 1861 the cargo passing through the Soo canals had an aggregate of 88,000 tons, with a value of $6,000,000; ten years later the cargo had grown to 585,000 tons, valued at $13,000,000; in 1881 the figures were 1,586,000 tons and $30,000,000; in 1891, 8,889,000 tons and $128,000,000; in 1901, 28,403,000 tons and $290,000,000; while the present climax was reached in 1903, with 34,674,000 tons and a value of about $350,000,000. It will be noticed that the value per ton has been decreasing through all these years, having been upward of $68 in 1861; $22.25 in 1871; $19.15 in 1881; $14.40 in 1891, and a trifle more than $10 in 1901 and 1903. It will further be noted by comparison with the figures given in the article on the Soo Canal Semi-Centennial that the total cargo moved in 1861 was exactly equal to the average daily movement of iron ore alone in 1904, and was only 70 percent of the average daily amount of freight of all classes in the year last mentioned.

When we come to compare the traffic through this canal with that through such a well-known water way as the Suez Canal, we find that our canal has passed far in advance of the other, from whatever standard of measurement it may be viewed. The number of ships passing through the Soo canal in 1903 was 18,596, and in 1904, which appears to have been a slack year, 16,120; against this we have the Suez canal statistics for 1900, 1901 and 1902 respectively, 3,441 ships, 3,699 and 3,708, while the number in the fiscal year 1905 is given as 4,237. When it comes to a consideration of the registered tonnage of the ships in question, the same sort of thing is manifest; for the Soo canal gave passage in 1903 and 1904, respectively, to 27,738,000 and 24,364,000 registered net tonnage; while the Suez canal in the four years above noted gave passage to only 9,738,000, 10,824,000, 11,248,000 and 13,402,000 tons respectively.

The other side of the question, that relating to the labor-saving devices in the way of loading and unloading machines, may be well illustrated by a comparison between the well-known equipment of the present day and the equipment which was used in 1839 for loading

the first cargo of grain ever shipped by water out of Chicago. The grain was shipped from a warehouse which may evidently be considered in some sense a prototype of the modern elevator, now so familiar in all large shipping centers where grain in bulk is handled, and was loaded into the brigantine *Osceola*. The grain was hoisted from farmers' wagons by hand power to the upper story of the building, which was fifteen or twenty feet back from the edge of the pier; it was then transferred by means of a chute, similar to those now in use, to the deck of the vessel, where it was measured in boxes each holding four bushels; these boxes were then covered and placed in the hold; the total cargo amounted to 3,678 bushels. At the present time one of the large grain carriers of the Lakes can receive her cargo of upwards of 200,000 bushels in actually less time than was required for the small cargo of the *Osceola* while the work requires the presence and labor of fewer men, and is accomplished at a much smaller expense.

This same thing holds true in perhaps even greater degree when we come to the consideration of such heavy commodities as coal and iron, and it is necessary merely to note that ships like the *Augustus B. Wolvin* and her big successors of the United States Steel Corporation's fleet, one of which is illustrated on page 335, where she is shown in the act of taking her initial plunge into the water, may be given a cargo of from 10,000 to 12,000 tons in the course of three or four hours, and may be completely relieved of a cargo of this mammoth size in from five to seven hours, to see that in this manner the facilities for handling these enormous quantities of material must be unsurpassed anywhere on the globe.

Small wonder is it then that the concurrent adoption of the most powerful machines for handling cargo of all sorts, installation of water way facilities capable of handling the most congested traffic in a wonderfully short space of time, and the adoption of standard methods in the construction of ships, notably in the spacing of their regular hatchways to fit the machines designed to operate through them, have resulted in the development of a truly wonderful industry, and one of which in every way we have a right to be proud. The only regret which we can utter in connection with this matter is that means have not been adopted looking to the establishment of an ocean traffic commensurate, not only in point of size, but also in adaptability and prosperity, to that which has been developed upon our great fresh water lakes.

The Development of the Marine Turbine.

Ever since 1894, when the Hon. Charles A. Parsons, of London, made his first installation on the triple-shaft yacht *Turbinia*, the development of the steam turbine as a substitute for the reciprocating engine for purposes of marine propulsion has been very prominently in the minds of naval engineers. The *Turbinia*, it will be remembered, was the first craft of any description to make a speed exceeding 30 knots, and the remarkable speed of 34.5 knots which this little boat of 100 feet achieved during the Diamond Jubilee celebration in June, 1897, has been equaled since by only two boats, both of which were over 200 feet long, and both, it may be added, were propelled by the same style of prime mover as that which actuated the nine screws of the *Turbinia*. These two boats were the *Viper* and *Cobra* of the British navy, both of which were lost three or four years ago.

Due to the extremely high rate of revolution required by the steam turbine for its efficient operation, its installation has been attended by many difficulties, and has proceeded at a much slower rate than would have been the case in the progressive times in which we are living had it been more readily adaptable to conditions which it found existent on entering the field. The theoretical best efficiency of the turbine, as is well known, is attained when the linear velocity of the rotating vanes is equal to one-half the velocity of the steam impinging upon those vanes, and as this figure is very high there remain but two alternatives to obtain the results which the best efficiency would require. The first and more obvious of these two is the acceptance of a speed of revolution so high as to enable the vanes to receive the steam under the conditions above set forth. The other alternative is to reduce the speed of rotation of the turbine, either by increasing its diameter in equal ratio to the reduction of rotative speed, or by some other device such as has been so successfully adopted in both the Parsons and Curtis types in connection with compounding. Both these devices have been adopted to a certain extent, though it is to the latter rather than the former that is due the greatest amount of effect in the desired direction.

The resultant turbine is so well adapted for all purposes of marine propulsion where a considerable speed of ship is required that it is now being rapidly installed in ships of all descriptions, from torpedo boats and destroyers to cruisers, and even, if current reports are to be credited, to battleships of the British navy, on the one hand; and to pleasure yachts, commercial steamers making short and quick passages across channels in various parts of the world, and now to the largest sizes of ocean liners, on the other. It is hard to foresee the ultimate limit of the usefulness of this engine, especially in cases where the speed to be maintained has a more or less constant value. There are considerable limitations, however, when we come to apply the turbine to the case of warships of the usual character, which have a maximum speed to be attained in cases of very infrequent occurrence, and a cruising speed, calling for perhaps one-fourth of the machinery power of the ship, to be maintained during at least 90 percent of the time the ship is under way.

ABSTRACT FROM RULES AND REGULATIONS OF THE AMERICAN BUREAU OF SHIPPING FOR SOUND, LAKE, BAY, AND RIVER STEAMERS, YACHTS AND TUGS.

EDITION OF 1904.

ARRANGED BY HARRISON S. TAFT.

1. Measurements.

1. Length. From forward side of stem to after side of inner or propeller post on range of the load water-line.

2. Depth. From base line (top of keel) to main deck (second deck in hurricane-deck vessels) at sides amidships.

3. Breadth. Maximum molded beam.

4. Tonnage.

Steam and sailing yachts. Merchant vessels for passengers only.	$\frac{\text{Length} \times \text{breadth} \times \text{depth}}{175.}$
Merchant freight; steam and sail vessels. Merchant freight and passenger vessels. All hurricane-decked vessels. Tug-boats.	$\frac{\text{Length} \times \text{breadth} \times \text{depth}}{150.}$

5. Scantling Number for Frames, Reverse Bars, and Floors. 1-2 B + D.

6. Scantlings under tonnage numbers: Keels; stems; stern frames; rudders; bulkheads; deck and hold stringers; outside plating, including flat plate keels; keelsons; stringers and tie plates on deck beams; deck stringer angle bars; deck planking and hold ceiling; anchors; chains; and warps. (See Nos. 7 and 8.)

7. Hurricane-Deck Vessels. Depth for determining the tonnage number for equipment is to be taken to half distance between the top of the second and the hurricane-deck beams at sides of ship amidships.

8. Full Poops; Top Gallant Forecastles and Inclosed Bridge Houses. When the length of one or the combined length of more than one of these structures exceeds 1-2 the vessel's length the tonnage number for scantling increased by 1-8 of itself will be the tonnage number for equipment.

9. Deck and Hold Beams. Scantling of same is to be determined by length of said beams amidships.

10. Stanchions. Scantling of same is to be determined by the depth from top of floors to top of main deck beams amidships.

2. Scarphs.

Scarphs of bar keels, stems, and stern posts should be not less than ten times the required thickness of the bar keel.

3. Stems.

Stems should be equal to bar keels in scantling. They should be rabbetted above the light load water-line for receiving the ends of the shell plating.

4. Stern Frames.

1. Stern frames of sailing vessels, of side-wheel, and of twin-screw vessels, should be equal to the scantling of the bar keel; with the aft end of their scarph with said keel at least one and a half frame spaces forward from the inside of the rudder post.

2. The stern frames of single-screw vessels should be forged in one piece; the part forming the keel between the two posts being of a sectional area equal to twice that required for the bar keel. The middle of the scarph of the stern frame with a bar keel is to be at least two and a half frame spaces forward from the inside of the propeller post.

3. Rudder posts should extend to and be securely fastened to a main-deck beam by a transom floor plate.

4. The thickness of the propeller boss on each side of the hub is to be not less than one and one-half times the thickness required for a bar keel.

5. The inner, or propeller post, when a balanced rudder is fitted, should be of 20 percent greater sectional area than otherwise required.

6. Gudgeons are to be spaced not more than five feet apart.

5. Flat Plate Keels and Center-Line Keelsons.

1. Center line keelsons need not be fitted to vessels of less than 15 tons.

2. Flat Plate Keels.

(*a*) A flat plate keel is to maintain its full midship scantling throughout. It is to lap the stem and stern frames for at least one and one-half frames spaces.

(*b*) When it is worked with a continuous vertical keelson, it is to be secured to same with continuous angle bars equal in scantling to the frames. The vertical keelson should extend above the top of floors a sufficient height so as to be embraced by two continuous fore-and-aft angle bars on the upper side of a horizontal plate stringer, worked on top of floors, on each side of said vertical keelson. Said stringer plates are each to be in width 2-3 the depth of midship floors, but of same scantling as said floors.

(*c*) When the tonnage is 1,250 and over, the continuous keelson is to extend above the top of floors 3-4 of a specified depth, with continuous double angle bars on top. When tonnage is 1,600 and above, a rider plate is to be worked on top of said angles for 3-4 length amidships.

3. Center Line Keelsons with Bar Keels.

(*a*) Vessels of 15, but under 100 tons, fitted with bar keels, are to have a middle line keelson of two angle bars riveted back to back worked on top of floors, all fore-and-aft.

(*b*) When the tonnage is 100, but under 200, a bulb plate of specified depth, worked all fore-and-aft, should be riveted between the above keelson angles; or an intercostal center line keelson, equal to the thickness of floors, can be fitted. The intercostal plates shall be secured to the floors with double clips equal to the reverse bars; they shall extend above the top of floors so as to be embraced by the above two keelson bars.

(*c*) When the tonnage is 200 and over, a center line plate keelson with top angles is to be worked on the top of floors in lieu of the above bulb plate.

When the tonnage is or exceeds 500, a rider plate of keelson-plate thickness is to be worked on top of said keelson top angles for 2-3 length amidships. In lieu of this plate keelson, a regular intercostal center line keelson, as stated under 3-*b*, may be worked as above, extending as far fore-and-aft as possible.

4. Center Through Plate Keel and Keelson.

(*a*) Said plate keel and keelson should extend from the top of floors to below the bottom of floors for a distance equal to the depth of a bar keel; with side plates of specified scantling fitted on each side so as to form a keel; all butts being well shifted from each other. A horizontal plate stringer, equal in width and thickness to the midship floors, is to be worked on the top of floors at the center line, and be secured to the top edge of the vertical keel plate with double clips equal to the reverse bars. When the tonnage is 650 and above double angle bars, riveted back to back, extending all fore-and-aft, are to be worked on top of and riveted to said horizontal plate stringer on the center line.

(*b*) When the plate keel and keelson extends above the top of floors the horizontal plate stringer should be worked in two pieces, one on each side of the vertical keelson; each in width to be 2-3 the depth of midship floors, and be connected to said keelson by two continuous angles riveted back to back embracing the top edge of the vertical plate keelson.

5. Intercostal Middle Line Keelson.

(*a*) When worked with a flat plate keel they are to be secured to same with double clips equal to the frames and have their top edge worked as when fitted to a bar keel as above.

(*b*) In vessels of 1,000 tons or above, a horizontal plate stringer is to be worked on the top of floors on each side of said keelson. Each stringer plate is to be of the same thickness, but in width at least 1-2 the depth of the midship floors; being secured to the intercostal keelson plates by two continuous angle bars similar to above.

6. Continuous plate keel and keelsons are to maintain their midship thickness all fore-and-aft; all other keelsons for 1-2 length amidships. Fore-and-aft of said 1-2 length they may be reduced similar as for floor plates.

6. Frames.

TABLE I.—EXTENT OF FRAMES.

Type of Ship.	
One- and two-deck vessels	All to the upper deck stringer plate.
In way of a raised quarter; a raised fore; or a topgallant forecastle deck.	" " said deck's stringer plate.
In way of a full poop or midship bridge house.	To said decks and to the main deck stringer plate alternately.
Hurricane deck vessels	All to said deck stringer plate for ¼ length from stem; abaft of said ⅛ length to said deck and to the main deck alternately.

In way of the lower rigging chain plates all frames should extend to the topmost deck.

1. The frames are to maintain their midship scantling for 1-2 length amidships, except in tug-boats, where the midship scantling is to be maintained throughout. Frames at all watertight bulkheads are to be worked double.

2. The frames are to extend in one piece from the keel to the stringer plate of the deck stated in Table 1, except when cut at the margin plate, as in double bottom vessels.

3. In yachts carrying ballast between the floor plates the frames should be worked double to the upper turn of the bilge in way of said ballast.

4. Scarph pieces equal to the frames and in length at least twice the center depth of midship floors are to be fitted at every frame at the center line except when a continuous center line plate keelson is worked.

5. Frames are to be worked double at the margin plate of inner bottoms when the reverse bars are cut at said point. The doubling pieces are to be long enough to allow of three rivets in each flange on each side of said margin plate.

6. When channel frames are adopted no reduction from their midship scantling will be allowed in the end frames.

7. Floor Plates.

1. Plate floors should be fitted to every frame in all vessels of 15 tons or above, being secured to a continuous middle line keelson with double clips equal to the reverse bars: joggled over the frames and reverse bars. They are to maintain their midship scantling for 1-2 length amidships.

2. For 1-4 length amidships they are to extend up the bilge above the base line to at least twice the center depth of floors, being equal to the depth of the molded frame flange at their ends. Fore-and-aft of said 1-4 length they may be gradually diminished in height at the bilge until they become straight on the upper edge; but in no case are they to be of less depth than their center depth amidships. The floors at the extreme ends of ships should be increased in depth so as to strengthen said ends.

3. In vessels with a good dead rise the floors may be worked straight on the upper edge throughout. Such

floors amidships must measure on the upper edge from bilge to bilge at least 1-4 the molded beam, or be in depth at the center line at least 1 1-2 times the center depth of ordinary floors; no floor plate being of less than this depth throughout the ship.

TABLE 2.—REDUCTION IN WEIGHT OF FLOORS.

Weight of Midship Floors. Lbs.	10 under 16.	16 and above.
For the first $\frac{1}{5}$ length at ends.....	1½ lbs.	1½ lbs.
" " second $\frac{1}{5}$ " " "	1½ "	3 "

Reductions to be figured from weight of midship floors. Said reductions will be allowed in the *fore part only* of vessels upon the Great Lakes with their machinery fitted aft.

4. The floors in the machinery space are to be 2 pounds heavier than otherwise; but in vessels of 15 knots or above, the floors under the engine bed should be 4 pounds heavier.

5. In sailing yachts with an extra heavy bar keel, or with a flat plate keel filled with ballast, the floors throughout should be 2 1-2 pounds heavier than otherwise. When a bent plate keel having lead ballast run into it is adopted, alternate floors for 1-2 length amidships should extend down and be secured to said keel plate with a welded knee clip equal to the frames; said clips lapping the frame ends for at least 18 inches beyond said keel plate.

6. The bulkhead floors should extend above the reverse bars so as to allow sufficient lap for riveting said floors to the bulkhead plating. Limber holes should be cut in all floors so as to provide a free flow for the bilge water to the pumps.

7. Floors, when built of two pieces, should have their butts so arranged that only those on alternate frames are located on the same side of the center line.

8. Transom Floors. At the middle line they are to be at least 1 1-2 times the center depth of the floors amidships, and be equal to same in weight. When the center depth of the transom floor is 12 inches or above it is to be secured to the stern frame with double clips equal to the frames. When said depth is less than 12 inches it may be secured to the stern frame by tap rivets.

8. Reverse Frames.

1. Said frames should be fitted to every floor in all vessels of more than 15 tons. They should maintain their midship scantling for 1-2 length amidships, except in tug-boats, where they are to maintain their midship scantling throughout.

2. In the machinery space of steam vessels the reverse frames are to be worked double on every floor. In vessels of 15 knots or above those on the floors under the engine bed are to be of the same scantling as the main frames.

3. In yachts, with the ballast placed on top of floors, the reverse frames should be worked double on every floor in way of said ballast.

TABLE 3.—EXTENT OF REVERSE FRAMES.

Type of Ship.	Tonnage.	
All classes.....	Over 100 under 250	All to 6 inches above the upper bilge keelson.
Steamers.....	250 " 1,000	To the main deck stringer plate and to 6 inches above the upper bilge keelson alternately.
Sailing vessels.....	250 " 500	
Steamers.....	1,000 and above	To the main deck stringer plate on every frame.
Sailing vessels.....	500 " "	

In two-deck vessels the reverse frames which extend to the main deck should extend to the top of the stringer angle at the face of the frames so as to have a one-rivet connection to said angle bar stringer.

9. Bilge, Floor Keelsons, and Side Stringers.

TABLE 4.—TYPE OF BILGE AND FLOOR KEELSONS.

Tonnage.	Lower Bilge.	Upper Bilge.	Floor Keelson.
Under 15	S A	....	....
15 " 50	D A	....	....
50 " 500	D A	D A	....
500 and above.	D A	D A	D A

S A = single angle bar. D A = double angle bars riveted back to back.

1. Bilge Keelsons. The bilge keelsons of Table 4 shall in all cases extend as far fore-and-aft as possible. In double-bottom vessels the lower bilge keelson is to be omitted.

2. Floor Keelsons.

(*a*) The double angle bar floor keelson of Table 4 is to be fitted on top of floors midway between the center line of ship and the lower bilge keelson. When the beam is over 30 feet, or the vessel has but little dead rise intercostal plates are to be fitted in connection with said keelson bars, extending as far fore-and-aft as possible; being clipped to the shell with single clips equal to the reverse bars.

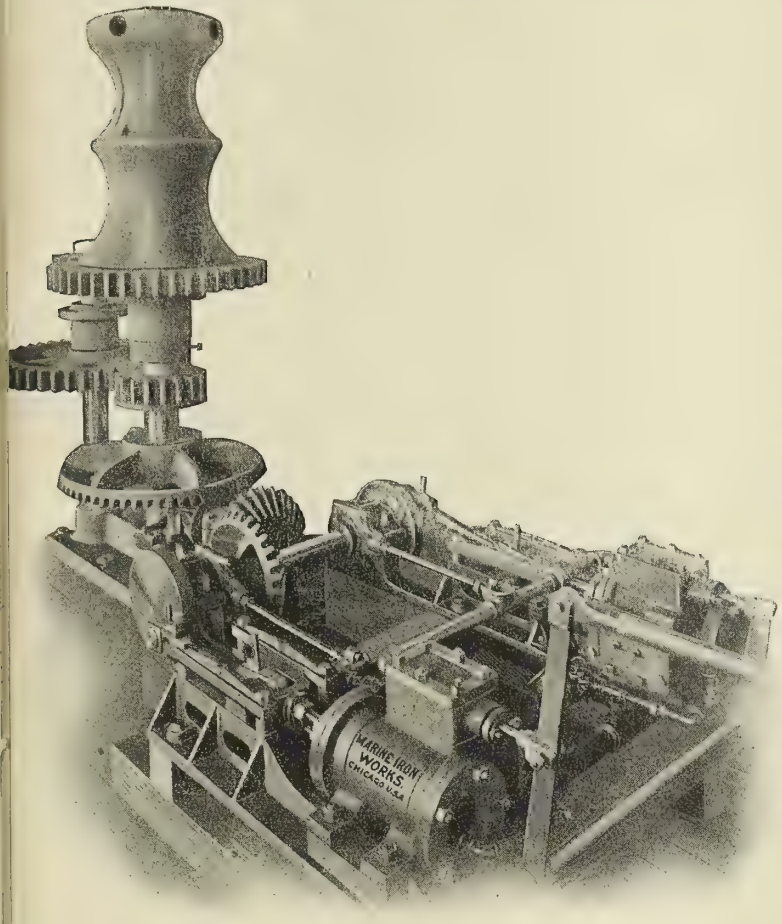
(To be continued.)

ENGINEERING SPECIALTIES.

A New Steam Capstan.

A special type of reversible steam capstan is designed and built by the Marine Iron Works, of Chicago, for river boats. They are adjustable for both speed and power, and suitable for most severe duty, dependability rather than first cost being the prime consideration. The principal dimensions are as follows:

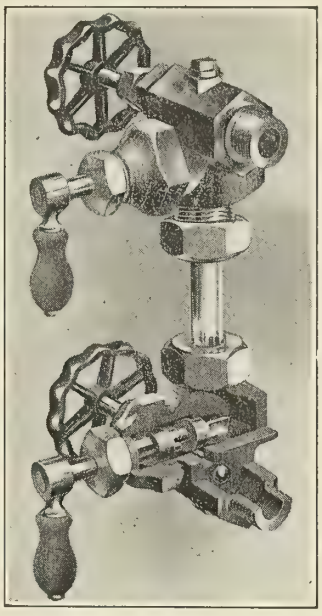
Total outside floor space, 8 feet 5 1-2 inches by 4 feet 2 1-2 inches; two double-acting 5 by 7 reversible engines; height of capstan from deck to top, 2 feet 11 1-4 inches; diameter of large drum, 14 inches; height, 16 1-4 inches; diameter of small drum, 11 inches; height, 19 inches; diameter of shaft, 5 1-2 inches.



The spur gears, bevel gears, bevel pinions, and miter gears are all made of steel, and both drums are made of semi-steel, the object being to obtain the greatest strength at the minimum of weight and space. The weight of capstan complete with engine is 3,700 pounds.

The Shallow Automatic Water Gauge.

Many efforts have been made to devise a boiler water gauge which will automatically shut off the escaping water and steam when the gauge glass breaks. Of the various inventions having this object in view, the Shallow valve seems to fulfill every requirement, and at the same time eliminate the defects that exist in other valves designed for this work. The Shallow gauge is exceedingly simple in principle and in construction. The automatic valve is not subjected to wear except when it is closed through the breaking of a glass, and this occurs only at widely separated intervals. The whole valve is constructed of brass, and the design of the passages and working parts is such that no trouble is experienced from the collecting of sediment or scale, and the consequent sticking of the valve. The action of the Shallow gauge when a glass breaks is so instantaneous that in practically every case some water still remains in the bottom of the

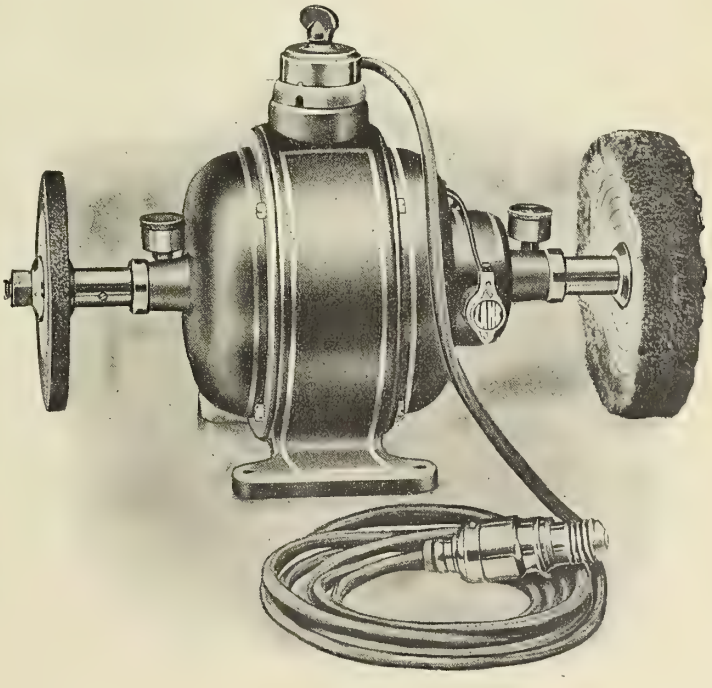


broken glass after the valve closes. A new glass is inserted at once, and the automatic valves brought into position for further service by the simple turning over once of the two automatic handles.

In connection with marine boilers in which very high steam pressures are carried, and about which the fire-room space is very limited, the advantages of the Shallow Automatic Gauge are even greater than in the case of stationary boilers, the danger from flying glass and hot water and the filling of the boiler room with steam being absolutely eliminated. The device is being placed upon the market by the William S. Haines Company, 140 South Fourth street, Philadelphia.

New Grinding and Buffing Motor.

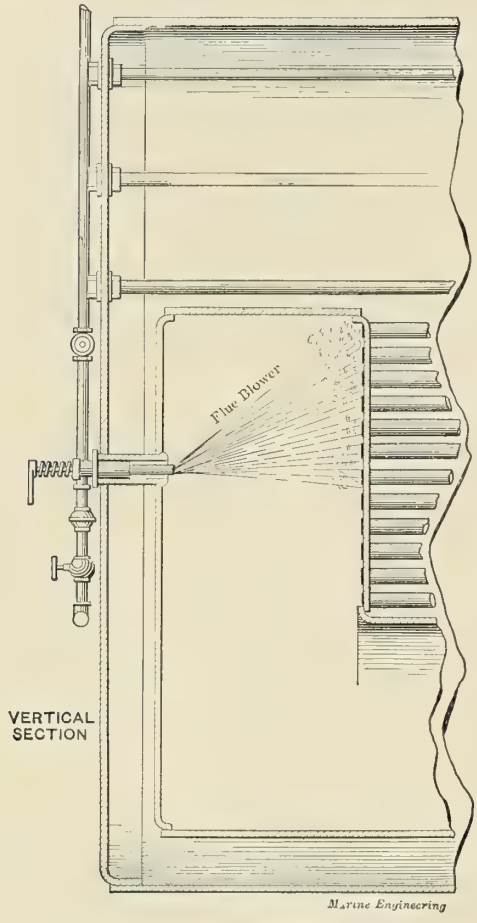
To meet the demand for a portable electrically-driven grinding machine, the Lamb Electric Company, of Grand Rapids, Mich., has been putting out an equipment of which we illustrate a size rated at 1-4 horsepower. The cut will show that the motor is mounted in the middle, with a buffer on one end and grinder on the other, and that the arrangement is so adjusted that it may be



connected up with any electric-light socket. The larger sizes, which run up as high as 2 horsepower, require suitable starting boxes, which are furnished in place of the snap-switch and plug used with the smallest size. The four sizes are built in two different series, one rated at 110 volts and the other at 220, though special voltages may be furnished on order. As the machine is very carefully balanced, smooth running is assured, as well as durability.

The Diamond Steam Flue Blower.

For the purpose of rapidly cleaning boiler tubes without the necessity for shutting down the boilers or reducing the speed of the engine, the Diamond blower is fitted as shown in the accompanying illustration. It is claimed that this practically does away with the work of the firemen in cleaning the tubes, absolutely prevents the accumulation of soot, and saves in a short



time its own cost by the saving of the hose which would ordinarily be used in connection with the old method of cleaning. It is further stated that a thorough cleaning of all the tubes in the boiler will take not more than five minutes, because in each operation a large cluster of tubes is cleaned all at once.

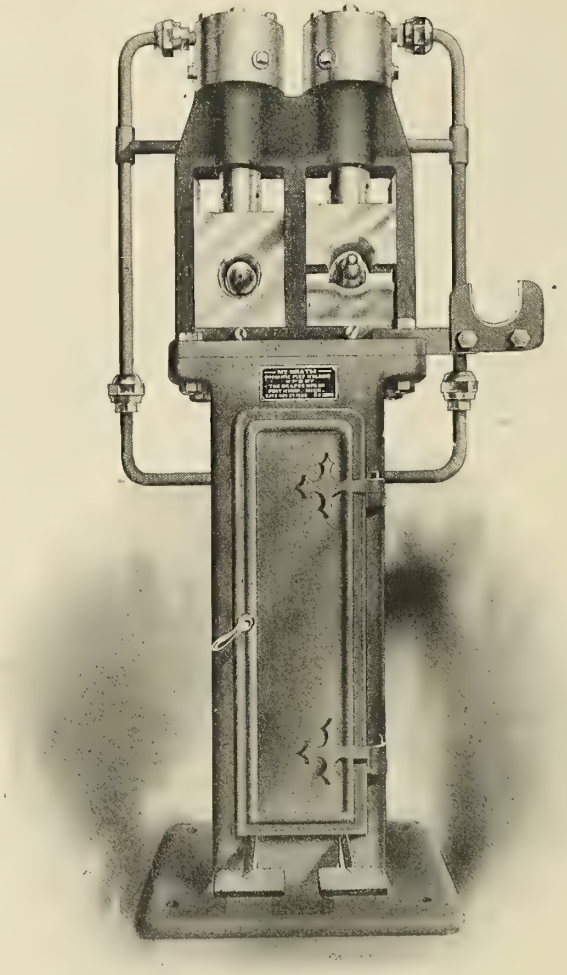
The Svea Caloric Engine.

The external combustion engine operated by hot air has received very little improvement in design or construction for a good many years, the great difficulty being that air is a very poor conductor of heat. By heating the air from below, however, the designer of the Svea engine has accomplished a result which it is believed is of considerable importance in this connection. A volume of cool air split up into thin sheets passes over heated plates at a predetermined velocity, and absorbs the heat radiated from these plates. An engine of 6 horsepower applicable to launches and automobiles is being put on the market by the Svea Caloric Engine Company, of 119 Nassau street, New York. It has a cylinder measuring 4 1-4 inches by 4 7-8 inches stroke, and makes 450 revolutions per minute. The heater is 20 inches in diameter and 16 inches long, with a heating surface of 60 square feet. The apparatus is applicable to the use of air, steam, or any other gas of similar character.

The Bard Adjustable Bushing.

Made by the Armstrong Manufacturing Company, of Bridgeport, Conn., this bushing has some new features which will recommend it at once to all users of bushings, as well as to the trade in general. It is fitted with hardened jaws which are moved to and from center by means of a cam plate, and by fastening the plate with the thumb screw the jaws are firmly held in any desired position. The adjustable jaws make a perfect center for the pipe

or rod, fit closely around the same, and insure the cutting of a straight thread. When necessary a crooked or drunken thread can be cut with this bushing as easily as with a ring bushing. When once attached to the die stock it can always remain there. It does away with the necessity of carrying a number of loose ring bushings, and saves the time now lost in hunting for and changing the bushing for each size of pipe.



The McGrath Pneumatic Flue Welder.

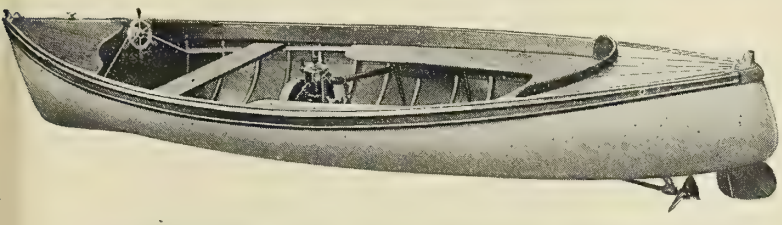
The McGrath pneumatic flue welder, illustrated herewith, is made by the Draper Manufacturing Company, of Port Huron, Mich. It was designed to expedite and cheapen the welding and

swaging of boiler flues, and is adapted for all sizes of flues up to a diameter of 4 1-2 inches. The cut shows the machine with one side set up for scarfing 2-inch flues, and the other for welding them.

The machine consists of a double-cylinder pneumatic hammer set on a base, and taking up a floor space of less than two feet square, and about 4 1-2 feet high. The frame and double cylinder are a single steel casting. The piston, which is made of hardened tool steel, ground to fit, has a diameter of 3 1-16 inches. At its lower end it is attached to the top die, being held in place by a key. The lower die is held rigidly in the steel frame. Air is admitted through a 3-4-inch pipe connected through the back of the valve box inside of the base. This valve box has two independent valves, connecting with a foot lever. Each side of the machine works independently, so that while welding is being done, the side used for scarfing is idle, and *vice versa*.

A New Power Dinghy.

This little boat is placed on the market by the W. H. Mullins Company, of Salem, Ohio, and is constructed of steel. The length of the one we illustrate is 16 feet, with a beam of 50 inches, a depth amidships of 21 inches, and a weight in running order of 350 pounds. The ribs, keel, stern, and bow post are of white oak, except that the ribs under the engine are of steel channels. The hull is made of galvanized steel covered with



aluminum paint. The engine consists in a reversible two-cycle motor with one cylinder operating a solid bronze propeller, and has a capacity of 1 1-2 horsepower, giving the boat a speed of a little under six miles per hour; with a 3-horsepower engine the speed is about 7 1-2 miles. It forms an excellent little yacht tender.

TECHNICAL PUBLICATIONS.

Practical Perspective. By Frank Richards and Fred. H. Colvin. Pages 56; illustrations 62. New York: The Derry-Collard Company, 1905. Price 50 cents; with two pads of isometric paper $1.00.

This book starts out with the most elementary principles of isometric perspective, and deals in the first part, which is from the pen of Mr. Richards, with the perspective representation of figures containing all dimensions in full proportionate size. The second part of the book is devoted to the use of isometric paper, a sample of which is bound in near the front cover. This paper, which is of the same general order as the familiar cross-section paper of engineering work, contains horizontal and vertical lines, as well as lines at an angle of 60 degrees with the vertical, and inclined both to the right and to the left. The use of this paper very greatly simplifies the production of drawings in isometric perspective, as is shown by the numerous examples given in the form of illustrations.

Beeson's Marine Directory of the Northwestern Lakes. Pages 272; illustrations 65. Chicago: 1905, Harvey C. Beeson, publisher, 341 to 351 Dearborn street. Price $5.00.

This is the nineteenth annual appearance of Beeson's Marine Directory, and, as in preceding years, it consists in a very complete directory of the steam vessels of the Lakes, the sailing vessels, the Canadian steamers and sailing vessels; and under separate headings are lists of the iron-ore carriers, the lumber vessels, and particulars of the machinery and boilers of all steam vessels on the Great Lakes. A large number of illustrations has been used, almost all being half-tones; they represent not only Lake ships, but ships on the coast, pleasure craft, ocean yachts, as well as buildings and views along the Sault Ste. Marie canal, it being intended as a sort of souvenir of the fiftieth anniversary of the opening of that canal, which occurred in June, 1855. Mention is made in the introduction of the tremendous progress in Lake navigation during the fifty years in question, from the first shipment of twelve barrels of iron ore to the present-day cargoes of nine and ten thousand tons each, and annual shipments of over twenty million tons.

QUERIES AND ANSWERS.

All reasonable questions concerning marine engineering received from and signed by subscribers will be answered by the Editor in this column. All communications must bear the name and address of the writer.

Q. 296.—Do sea tugs, like *Gypsum King*, average, when towing, over nine knots, and about how many tons do they burn in twenty-four hours when towing? Is she not the most powerful tug afloat (excepting the *Astral*) which burns oil if I am not mistaken?

I am designing a sea tug very much like *Gypsum King*, and I want to know just how large the dimensions of boiler and engines should be and where they should be placed? W. J. E. and J. L. D.

A.—We are informed by the J. B. King Plaster Company, who own and operate the tug *Gypsum King*, that with a load in tow of 6,500 tons an average of 6 1-2 knots is maintained, the speed, light, being about 15 knots, and we believe that this tug is capable of maintaining a speed of 9 knots with about 4,000 tons in tow. The coal consumption has been given us as from 12 to 14 tons per day when running at full power.

This tug has been very completely covered by a description in Marine Engineering, at page 116, for September, 1899. This gives the positions of machinery together with dimensions of the same. We might state, however, that the engine is of the triple-expansion type with cylinders 17, 27, and 45 inches in diameter by a stroke of 36 inches, while each of the two single-end boilers has a diameter of 13 feet and a length of 11 feet 2 inches.

Q. 297.—Be so kind as to answer the following in your Queries and Answers column:

Given a triple expansion marine engine to develop 1,900 I. H. P.; R. P. M. 90; W. P. = 185 lbs. (Howden forced draft), for a merchant steamer 5,000 tons displacement, 12 knot speed.

(*a*) Please show method to determine the economical speed for this vessel.

(*b*) How boiler pressure must be reduced for this purpose.

(*c*) How will it change the efficiency of the engine if the cut-off (0.57) in H. P. C. remains the same? I mean will it change the factor f in the formula $p_m = f\left[p\frac{(1+\text{hypolog}\,r)}{r} - p_b\right]$ or not?

It may be assumed that the back pressure in the condenser p_b is equal to 4 pounds in every case, and $r = 11$.

The principal dimensions of engine are 25, 38 and 62 1-2 inches by 40 inches stroke. V. T.

A.—(*a*) The economical speed for a ship of the class mentioned is a factor not at all defined in the term above mentioned, as it might be from an engineering standpoint one thing, and from a commercial standpoint quite another. That is to say, from an engineering standpoint, a very low speed would be found to give the greatest number of miles per ton of coal burned, whereas from a commercial standpoint, when we take account of the fact that the ship is all the time under fixed charges, as interest on first cost and for deterioration, and, furthermore, that the officers and crew are drawing fixed salaries per month, it is seen that a low speed would increase all of these items per mile traveled by the ship, and that as a result the most economical speed would be considerably higher from a commercial standpoint than would be the case from the standpoint of the engineer alone. A determination of the correct value for this is practically out of the question from a theoretical basis, and can be obtained only by means of tests with the ship actually in service, and by computations from the results of these tests.

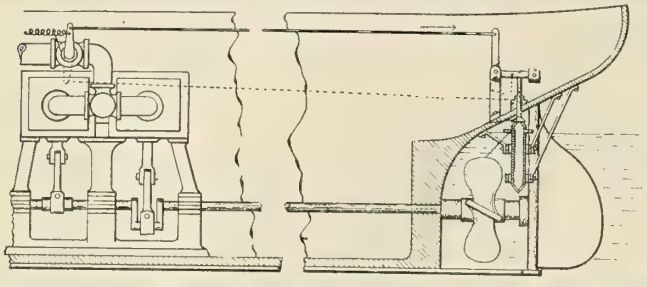
(*b*) If the speed determined upon as an economical one is below the best sea-speed of the ship, the boiler pressure will be reduced in order to decrease the number of revolutions per minute to such a point as to give the new speed. A determination as to how much of a reduction would be required may be made roughly by computing, first, the horsepower required to propel the ship at the new speed as compared with that for which the engines were designed, and then reducing the boiler pressure in approximately the ratio of the square root of the figure obtained by dividing the new horsepower by the old. This follows from the fact that the revolutions per minute will vary pretty closely with the steam pressure, and that the horsepower will vary as the product of the two.

(*c*) With the cut-off in the high-pressure cylinder remaining the same under the new conditions, the card factor, *f*, in the formula quoted, would remain about constant, and the mean effective pressure would be reduced in a slightly greater ratio than would the pressure at the engines, because of the fact that the subtractive item of back pressure is assumed to remain the same.

SELECTED MARINE PATENTS.

791,132. DEVICE FOR CONTROLLING THE MOTIVE POWER OF VESSELS. G. G. BOE, TORONTO, CAN.

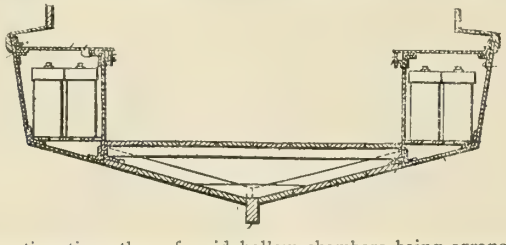
Claim.—1. In a device for controlling the motive power of vessels, a hanger attached to the stern part of the vessel, said hanger consisting of circular rings arranged one above the other, said rings having brace-arms extending therefrom and adapted to fasten to the said vessel, a cylindrical buoy encircled by the said rings, said buoy terminating in conical-shaped ends, a reciprocal rod extending through the said vessel, one end of said



rod engaging with the upper end of said buoy, and the other end engaging with mechanism adapted to open and close the throttle-valve of the motive power; means by which the said buoy is supported in the said rings. Four claims.

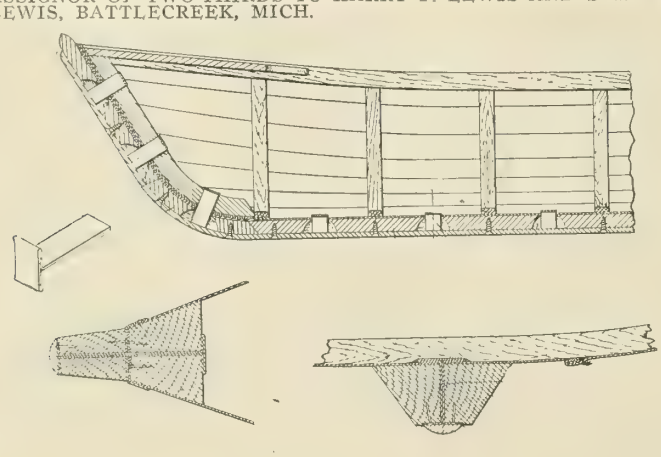
791,242. BOAT OR LAUNCH. JOHN C. BURCHER, PHILADELPHIA, PA., ASSIGNOR TO HARLAN PAGE, GERMANTOWN, PA.

Claim.—3. In a boat or launch, a solid bottom and side walls, and hollow trunk-like chambers introduced into the respective side walls and



forming continuations thereof, said hollow chambers being arranged in connection with said side walls so as to increase the buoyancy and balancing of the boat. Three claims.

791,630. BOAT. MORGAN M. LEWIS, BATTLECREEK, MICH., ASSIGNOR OF TWO-THIRDS TO HARRY P. LEWIS AND SYRA E. LEWIS, BATTLECREEK, MICH.



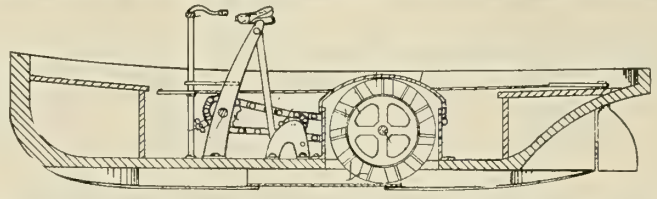
Abstract.—The objects of this invention a e, first, to provide an improved boat having a sheet-metal skin or shell which is economical to produce and strong and durable; second, to provide in a boat having a sheet-metal skin or shell an improved keel and means for securing the same in position; third, to provide an improved boat having a sheet-metal skin in which packings or gaskets are dispensed with. Seven claims.

792,121. STEERING DEVICE FOR POWER-BOATS. JAMES J. DONOVAN, PEABODY, MASS.

Claim.—1. The herein-described steering device, consisting of a wheel-carrying spindle, a pinion attached thereto, a longitudinally-movable rack-rod actuated by the pinion, a guide-sleeve in which said rack-rod is movable, means for adjustably securing said sleeve and means for adjustably securing the spindle and pinion in the required position. One claim.

792,687. MARINE PROPULSION. KNUD O. WOLL, NEAR TACOMA, WASH.

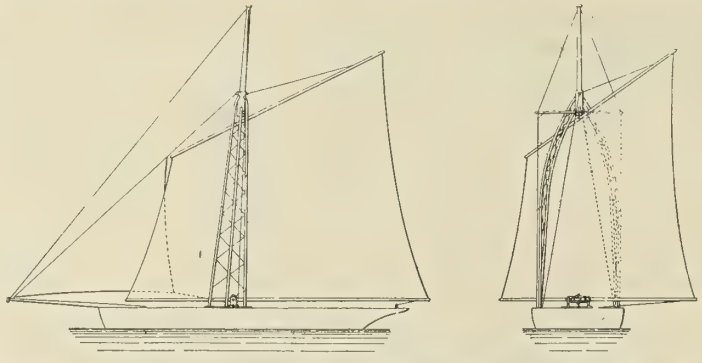
Claim.—In a marine propeller, the combination with a vessel having a central hole in the bottom thereof, a propeller-box within said vessel and being open at the bottom and covering said hole, a paddle-propeller journaled in said box and passing through said hole and below the vessel, a watercourse-box secured to the bottom of said vessel and open at its ends



said watercourse-box extending forward of said hole in the vessel and being widest at its forward end, and a pedal-actuated set of sprocket-wheels and chains whereby said paddle-wheel may be rotated in said propeller-box. One claim.

792,924. SAIL FOR VESSELS. GEO. E. POSGATE, GRAVESEND, ENGLAND.

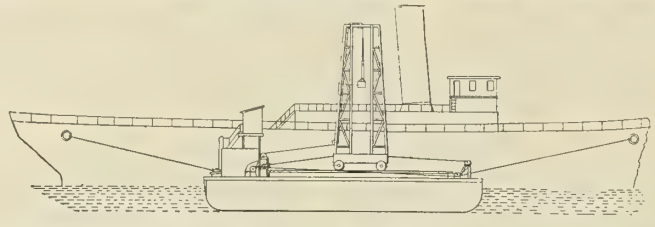
Claim.—3. A single-masted fore-and-aft rigged vessel having a mast consisting of rigid shrouds extending upwardly and inwardly from either side and rigidly attached thereto, and also to each other at their upper ends,



and a sail extended on a boom pivotally mounted between the said rigid shrouds to move angularly with respect thereto, the said boom and sail extending both fore and aft of the said pivot mounting. Three claims.

793,122. MECHANISM FOR COAL-BUNKERING SHIPS. JERE. CAMPBELL, BOSTON, MASS.

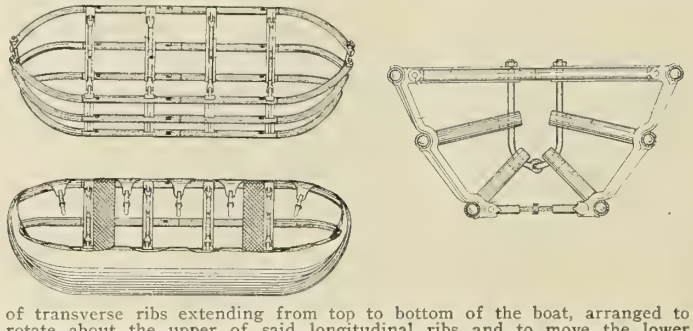
Claim.—1. In a coal-bunkering apparatus, a vessel, a barge, a tower mounted on said barge, and means whereby said barge and said vessel



may be moved with relation to each other while said tower is maintained in fixed relation to said vessel. Three claims.

793,230. PORTABLE BOAT. JOS. ROSENBERG, CHICAGO, ILL.

Claim.—4. In a portable boat, a series of longitudinal ribs consisting of tube-sections having telescopic ends for each side of said boat, the ends of said longitudinal ribs yoked together for relative movement, a series



of transverse ribs extending from top to bottom of the boat, arranged to rotate about the upper of said longitudinal ribs and to move the lower of the longitudinal ribs toward and from each other, and turnbuckles connecting the lower ends of said transverse ribs whereby the latter may be moved to expand or contract the sides of the boat. Five claims.